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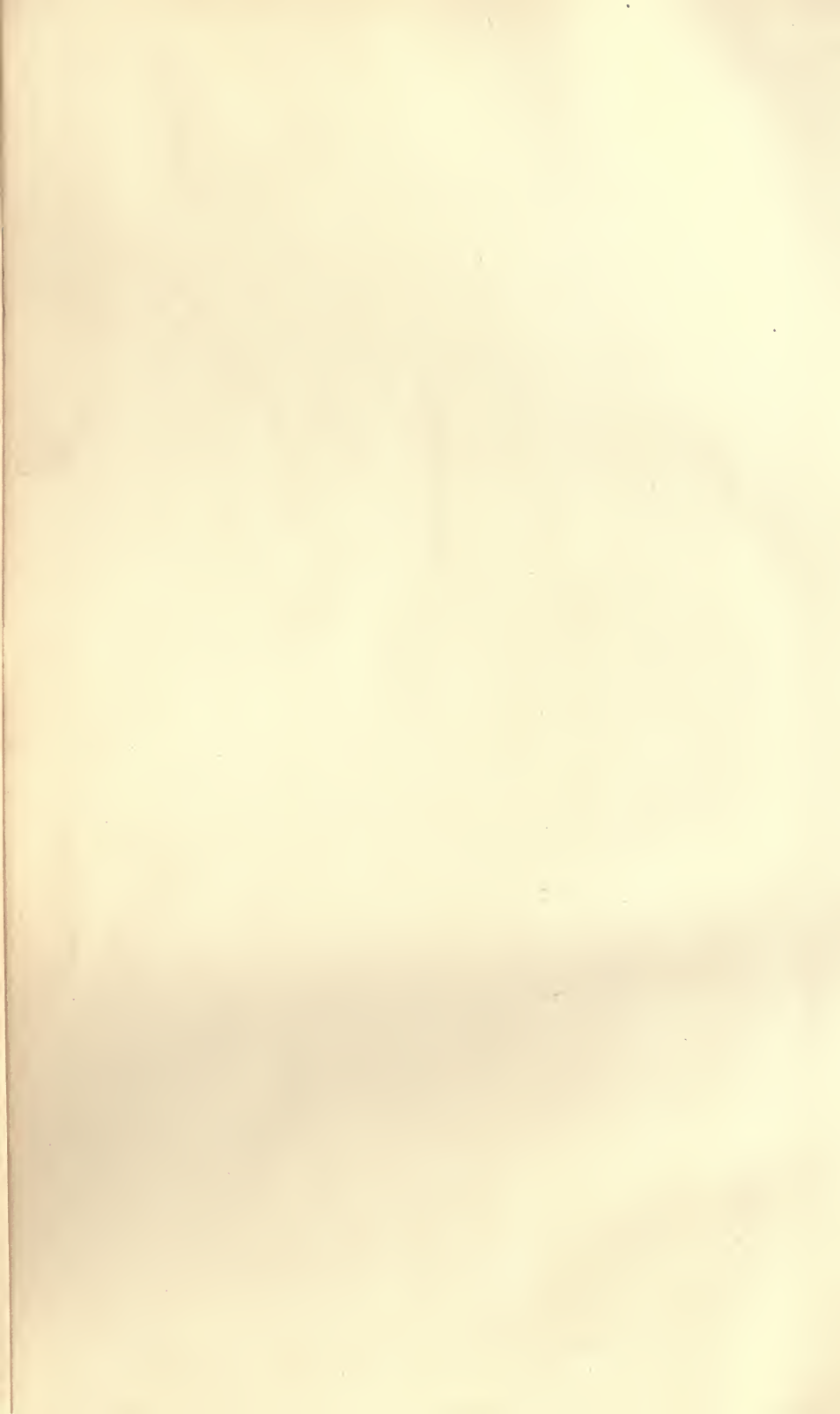


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LAW AND BUSINESS OF ENGINEERING AND CONTRACTING

WITH NUMEROUS FORMS AND BLANKS FOR
PRACTICAL USE

BY
CHARLES EVAN FOWLER

CIVIL ENGINEER

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS, MEMBER CANADIAN
SOCIETY OF CIVIL ENGINEERS, MEMBER SOCIETY FOR THE PROMO-
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"The simplest natural objects have bearings which calculation does not touch, and appearances and relations which definition fails to include."

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PREFACE

THE matter contained in this book is the result or elaboration of a series of lectures delivered to the engineering students of the University of Washington during several years past. The additional matter that has been added in the shape of forms of contracts, specifications, and blank business forms will be found of advantage to both the student and the practicing engineer, and it is hoped that the entire work will be a valuable addition to the engineer's library.

It is sincerely hoped that the discussion of the relation between the engineer and contractor in Chapter I will result, in many cases, in a better feeling between the engineer and the contractor as they may come together on contract work. The writer has made it a lifelong study to further the good feeling that should exist between them, but must confess to having made so little progress as to despair of seeing a better condition of affairs result. Yet the writer is convinced that by continually keeping at it, on the part of those having this matter at heart, much good will eventually come about.

The subject of ordinary forms of contracts is one on which there has been much written, and is a subject on which the engineer should be well posted as to fundamentals. In addition to reading the standard works on the subject of contracts, it is very easy for each engineer to get together such standard forms as are valuable and file them in shape for handy reference. It is believed that the forms given herein will be found of much use to everyone as a basis for a larger collection.

The subject of ordinary specifications, as treated in Chapter III, is intended to serve as a discussion of the anatomical structure of ordinary specifications. No better specifications are to be found in the world than those in use by the great

railroad systems of this country; and practically all of those published by the engineering journals and kept on sale for general use are of the best of their respective kinds.

Specifications of the War and Navy Departments, as discussed in Chapter IV, are models of concise description of the work to which they refer, although it is best that the engineer should so carefully study the construction for which he is to let a contract that nothing is left to the judgment of the bidder, although this is not always possible.

In drawing up a special contract, as set forth in Chapter V, it is necessary to be fully conversant with all of the contingencies that are likely to arise on the work in question, and to cover everything as fully as possible, so as to leave as small a number of matters for dispute as may be. A short discussion is given of the principal kinds of insurance, and the engineer should be conversant with the ordinary forms of insurance and ordinary forms of policies. The fundamental principles governing the formation and operation of corporations should be fully understood by the engineer and the contractor.

The inspection of engineering work, as discussed in Chapter VI, is intended to cover this subject in only a general way, and each one engaged in contract work, whether on the engineering or the contracting side, should keep a loose-leaf book with all the data necessary for the inspection of each class of material and of each class of construction.

The subject of estimating quantities and costs is the largest subject with which the engineer and the contractor have to deal, and while numerous books have been published on the subject, they are only of value in a general way, and are to be referred to with great caution, particularly as regards the cost of doing work. On each contract undertaken conditions are different from anything that has been done before, and the engineer or contractor who does not take cognizance of local conditions and use his judgment in raising or lowering tabulated costs of similar work, is sure sooner or later to come to grief. This is more particularly true as to the amount of work that any particular piece of plant will do, as the amount

actually done is very often only a fraction of what is guaranteed by the makers of the machinery, due to local causes of which they have no knowledge.

The subject of bidding on work is discussed in Chapter VIII, but it is well to remember that the very successful contractor, like the real artist or real musician, is born and not made to order. While you may become acquainted with hundreds of contractors, you will only run across a few in your lifetime who are fully suited to the business.

Organization of work, as discussed in Chapter IX, is gone into in a very general way, inasmuch as, in every case, "the punishment must be made to fit the crime," but in almost every concern there is a useless amount of organization, or red tape, that seriously hinders or impedes the work.

The subject of Contract Law has been covered in Chapter X, in a synopsis or outline, which has been gathered from "Clark On Contracts" in the Hornbrook Series, which the reader is advised to add to his library.

The subject-matter of the entire book has developed largely as a personal relation between the writer and a class of students, and the endeavor has been made, in revising and enlarging, to remove the personal element as much as possible. It is hoped that it has not been retained to the extent that it will be obtrusive.

CHARLES EVAN FOWLER.

SEATTLE, WASH.,
November, 1908.

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LAW AND BUSINESS OF ENGINEERING AND CONTRACTING

CHAPTER I.

THE RELATION BETWEEN THE ENGINEER AND CONTRACTOR.

IN seeking for some illustration of the relationship which too often exists between the engineer and the contractor, no more apt parallel comes to mind than the relation existing in an old-fashioned horse trade between two horse traders. The picture is a familiar one to some of you, no doubt, of the two traders with their questionable steeds, watching each other out of the corners of their eyes, while each makes an examination of the other's horse. All of the tests known are tried to see if the horse's eyes are good; his teeth are examined to make sure of his age, and the examination is a very careful one at that, to make sure that the horse's teeth have not been filed up for the occasion. The horse is paced around to see if it is string halt or lame, likewise trotted a distance to see if it is wind-broken, run down hill to see if it is stove up, and examined for ringbone, spavin, and all the ills that horseflesh is heir to. Then dickering begins as to the amount of boot to be paid by one or the other, each word and action indicating the distrust that the one horse trader has for the other.

While, perhaps, the engineer sometimes has grounds for so treating the contractor, owing to his having at some time fallen into the hands of a contracting firm that did not treat him squarely, and while the contractor on the other hand has reason to mistrust the engineer, by reason of his having some time or other been up against a too exacting engineer, I am sure that a great deal of the trouble that is often found to exist on contract work, between the engineer and contractor, would be avoided if the parties met in business relations with less suspicion and distrust each of the other.

As to some of the fundamental reasons for such a feeling, it is well in the first place to examine the education of the engineer. Unfortunately a large proportion of those going into engineering practice have never had any business training. Happy indeed is the engineer who has been fortunate enough to have had some years of business training prior to attending a university, as a very large proportion of engineering work entails the necessity for the carrying out of considerable business in connection therewith. In fact, there is no branch of business with which it is not a splendid idea for an engineer to be more or less conversant and to have more or less at his fingers' ends. As a matter of fact, the engineer usually graduates without any business training whatever, having spent the years previous to his college work in the common schools and high school, with little opportunity for rubbing up against business affairs, either small or large. This is one reason why a great many engineers are being so poorly paid for the services rendered. It is no unusual thing to find an office with fifteen or twenty engineers and draftsmen employed, where there are only two or three who have had any business experience, the training of the majority having been entirely along the lines of trigonometry, analytical geometry, calculus, astronomy, mechanics, a little work in literature, political economy, and the engineering studies required in the ordinary college course.

These studies are all very well in their way, but the engineer who is a good accountant, who writes a good hand, and who has some idea of business principles, has a great lead in the race over his fellows when starting into the practice of any branch of engineering. The average young engineer must fully realize that for the first year or so his services are of questionable monetary value. One of the writer's assistants for many years objected very strongly to the number of new graduates that were taken into the office every spring, saying that he was obliged to practically do their work all over, at least the assistance and explanations required were of more bother than their work amounted to. This would be much changed if the college graduate had a reasonable amount of business training.

While referring to this matter, it may not be amiss to tell how the new graduate is often received by the practical man when he comes in contact with either the practical field engineer

or the practical man with whom he finds work. The writer's first position was with one of the eastern railroads which owned a large amount of coal lands. The assistant engineer, or transit-man, was a man who had worked up from axe-man, and who thoroughly despised the sight of a college graduate. Every move made by a new man was severely criticised, and problems were constantly brought up intended to stump the beginner in practical work. One of the duties of the office each month was the measurement of the coal taken out of the mines, by measuring up three dimensions of each room, and then the office work of multiplying each set of three dimensions together to get the cubic feet of coal removed, which result was afterwards multiplied by a constant to arrive at the number of tons. As this assistant had become very proficient in making these multiplications, the writer's attempt to expedite the work by using a slide rule was ridiculed. But by the use of a reciprocal scale the three numbers could be multiplied together by one operation, therefore the practical man had to acknowledge himself defeated. In another instance a curious turnout problem which had been found impossible to solve by any ordinary method was proposed. After the solution of it by the application of analytic geometry and calculus, nothing more was heard of anything being impossible, and so far as the writer was concerned this particular instance was a final victory. Contractors are wont to treat young engineers with a similar disdain because so many of their ideas are purely theoretical. In recent years, however, it is more and more common that contractors on important works and skilled engineers of large contracting firms appreciate the fact that all engineers must get a start and gradually become acquainted with the practical side of work. The training of a contractor is usually of a more positive character than that of an engineer, inasmuch as he learns immediately what can be done with the forces of nature, and what results when they are defied.

The engineer must remember that it is necessary to meet a contractor on some common grounds. When the engineer is diplomatic in giving his instructions and suggestions, the contractor soon learns to value his appearance upon the work, for he finds the engineer of more value than harm.

A large piece of work which the speaker has in mind, costing nearly one million dollars, was recently carried out under the

direct charge of a young engineer of six or eight years' experience. While careful to see that the spirit of the plans and specifications was complied with strictly, he rendered such signal service to the contractors that they became fast friends; for there can be no question but that the assistance so rendered the contractor represented the difference between a loss and a handsome profit. As is true in every other walk in life, there is no question that contractors are met with who are constantly seeking to take unfair advantage; yet it should be a satisfaction to both engineers and contractors to be able to point to works executed throughout a lifetime, every one of which is a source of pride.

On the other hand it is a very common fault with engineers to entertain suspicions of all contractors, and to enforce rigidly the clause of a specification, where changes proposed by the contractor would very much improve the work. An engineer should remember that it is out of the question for any specifications to be more than a general guide in many respects, as is recognized by the quotation printed on the cover of the writer's "General Specification for Steel Roofs and Buildings": "The simplest natural objects have bearings which calculation does not touch, and appearances and relations which definition fails to include."

It is advisable to call attention at this point to the fact that a great deal of trouble between engineers and contractors is due to a lack of diplomacy on the part of the engineers' inspectors.

Large and important contract works usually have a resident engineer in direct charge, to whom are referred all questions of any importance; and as he is usually an engineer of considerable experience, it may be assumed that his experience with men and affairs guarantees a reasonable degree of diplomatic ability. Where the work is of medium size or of minor importance, an inspector is employed who is not an engineer but a man with some practical knowledge.

It is a pleasure to state that in an experience of twenty years it has been the writer's good fortune to find these men as a rule very agreeable and capable, but occasionally one is met with who, while he may have a good knowledge of his work, has no aptitude for getting along with men. The result in such a case is simply to "queer" the whole job, whereas by the exercise of a reasonable amount of diplomacy all would be harmony and the best results would be obtained in the execution of the

work. Such an inspector usually fools himself, for he does not get as good work as the contractor is ready to furnish. The specifications on a large amount of steel work called for painting with turpentine asphaltum, and the contractor purchased a supply of sixty-five-cent asphaltum in barrels. The inspector was incensed that he had not been consulted before its purchase, although no particular brand was specified. He demanded that numerous samples of various brands be ordered for him to select from. These were obtained, and tried by him, with the result that he selected a thirty-cent asphaltum, and the better brand already bought was set to one side. Had he known how he cheated himself, you can imagine he would have appreciated that it is well to have faith in the integrity of the contractor until such a time as he has proved not to have warranted such confidence.

While we read a great deal about dishonest inspectors, you may rest assured that such stories are often greatly overdrawn, as you will find them no worse than the rest of mankind. More harm is done by the "too honest inspector," if we may assume such a degree of goodness, than by the dishonest one. As one of our prominent engineers said to the writer once in speaking of such a man, "He is so honest he leans over backwards." Later we shall discuss the clauses in specifications which are so drawn that the engineer or inspector can, if he so wills, cause great monetary loss to the contractor by demanding better work than was contemplated. Such a clause would be one which required everything to be furnished to the satisfaction of the engineer, after all had been specified of certain brands and qualities. The engineer would see that he might curry favor with his principals by demanding that some other kind of material be used "to his satisfaction."

The engineer should endeavor to be, in so far as is possible, a mediator between his principals and the contractor, seeing that the one gets the result paid for, or results equally as good, and that the other gets the best show possible to make money in carrying out the work to reach the desired end. Specifications should, so far as possible, leave the method of doing the work to the contractor, as one contractor may have plans and methods different from those known by the engineer, which will enable him to bid much lower than his competitors.

It will doubtless be understood what is meant when the statement is made that often the engineer leaves too much in the hands of his young assistant. The graduate in beginning his professional career must not value lightly the responsibilities of his work, but must decide all questions submitted to him in as judicious a manner as possible, calling upon his chief for instructions and information whenever any doubt exists. Lest some one may interpret this as a bid for temerity, let me state that such is not the case, as one of the first things to know wisely is your own powers, taking for your motto, "Nothing is impossible to the engineer." Time and again has the beginner come to me with the declaration that this or that feature was impossible; but he soon learned that there were always ways to accomplish the most difficult engineering feats.

Some clauses and features of specifications which make trouble between the engineer and the contractor have already been mentioned, and we may briefly refer to some other points which should be avoided in writing specifications for any work.

All requirements should be sincere, and not made with the view to becloud the minds of the bidders; even where the engineer is sincere, clauses may be contradictory and thus obscure the intent.

Some engineers are entirely too general in their specifications, so no two bidders on the work will bid on the same thing. There is danger on the other hand of being too exacting, making it difficult for some bidders to comply. Frequently there are cases where no bids at all are received, because no bidder can be found who is willing to try to satisfy so exacting an engineer.

There may be clauses so drawn as to be not only exacting but to make it practically impossible for the contractor to comply.

Mention has already been made of the wisdom of leaving the method of doing the work to the contractor, as the ideas of the engineer as to plant and method may be much more expensive than necessary. One of the largest bridges which have been constructed in this country, on which the writer was engineer to the contractors, was let to a firm which in turn sublet half of the work of erection. The engineer of the original contracting firm conceived a splendid scheme of erection, and thousands upon thousands of dollars were spent on the plant. Fortunately the subcontractors were not bound to this method on the duplicate

half, and after due consideration by the writer of these expensive plans, a scheme was formulated which resulted in a saving of upwards of three thousand dollars in the initial cost of doing the work.

Clauses which in any case favor one manufacturer or one bidder as against others should be avoided. When it seems necessary to specify one particular brand of material or supplies, the bidder should be allowed to supply any other make equally as good. In saying this, it is not the intention to rehash the stereotyped drug-store joke about having something equally as good.

It is frequently possible for the engineer to copy portions of an old specification for use on some new work, and too often this is turned over to a clerk or stenographer, and the engineer fails to check over the new copy, with the result that clauses creep in which do not belong there and which cause trouble. This is apt to reflect on the engineer's ability, and in some cases on his integrity; or perhaps litigation may result. A case of this kind recently occurred, where a clause copied by mistake required the contractor to furnish expensive work which he had not figured on, and a suit resulted at great expense, in which the contractor was finally victorious. He was reimbursed for the more expensive construction, as the clause was obviously extraneous.

When the engineer has received the bids and some are found to be too abnormally low, he is simply inviting trouble for himself and for his principals if any of such bids are accepted. That is, this is the case in the great majority of instances, although there are times when good and responsible contracting firms take work low simply to keep part of their forces employed.

The methods of payment for work which are often specified are conducive to great friction, as some specifications call for the retention of from fifteen to thirty per cent of the monthly estimates until the completion of the work. Many engineers do not appreciate the large amount of capital necessary to carry on a contracting business, or they would limit such retention to not more than ten per cent. When good bonds are furnished by the contractor there is no need for anything to be retained at all; and as a result the work can be let more cheaply. Not content with retaining such a large percentage of the monthly payments, some engineers make their monthly estimates abnormally low,

so that in effect often fifty per cent is held back. Do not let work to a contractor from whom you would deem it a necessity to retain more than ten per cent of the monthly estimates.

Much has been said of the part the engineer should play toward harmony with the contractor, and it will not be amiss to tell some of the things a contractor should do to the same end, as some readers will doubtless be contractors or contractors' engineers.

The contractor should take a contract expecting to carry out the work strictly in accordance with the specifications, or at least he should put in a bid on this basis, and then submit supplementary bids based on any changes he desires to make either in the make-up of the work or in the method of doing it.

Where the specifications do not give preference as to method and the contractor proposes to use some new or novel method, or one which he may have doubts about being pleasing to the engineer, he should thoroughly discuss this before bidding.

The contractor should let contracts for his materials with the distinct understanding that the material man is to fulfill the specifications exactly and to fully satisfy the engineer.

Should the contractor let any subcontracts, it should be only to thoroughly reliable parties, or such as he would be satisfied to have execute work for him personally.

Plant of the best kind should be supplied, and if old plant is used it should be put in good repair. This is always best, as good plant will often insure a profit on work, where the use of old plant would cause loss. Where new plant is to be purchased, it should be satisfactory to the engineer, everything else being equal.

The class of labor employed is often a source of contention, but any trouble from this source can be avoided by employing only the better class of help of every kind, as you will find, for example, that a mechanic skilled enough to be paid \$3.50 per day will do from twenty to twenty-five per cent more work than the average workman paid standard wages of say \$3.00 per day.

When it comes to foremen and subforemen, the matter of difference in wages between the best man you can get and one of average ability amounts to nothing at all from a financial point of view, as compared to the saving in the carrying out of the work, the handling of men, and the satisfying of the engineer.

In closing, let me quote the foreword of Cooper's Specifications, for the guidance of both the engineer and the contractor:

"The most perfect system of rules to insure success must be interpreted upon the broad grounds of professional intelligence and common sense."

Instead of the modern principle of "Do others before others do you," let the motto be the one which has won out from time immemorial, "Do unto others as you would have others do unto you."

In carrying out this principle it need not be forgotten that it is necessary to arise early in the morning and keep wide awake all day to see that you get your just dues and that the other fellow doesn't do you.

If any one is disposed to forget that "Honesty is best," don't let him forget that, at the very least, "Honesty is the best policy."

CHAPTER II.

ORDINARY FORMS OF CONTRACTS.

BEFORE taking up the subject of ordinary contracts, it is well to impress upon the mind of the reader some ideas about business, especially the necessity for promptness and punctuality in keeping appointments. One of the worst things about some business men is that they do not keep their appointments.

When going into business, do not forget when an appointment is made to keep it. A business man's time is worth money. An engineer's time is worth money, and to compel him to sit around for a half hour or more waiting for a man to keep an appointment is really losing money for him.

I would first call the reader's attention to the book on Commercial Law by Bolles, which is a good short treatise.

The first thing to take up, in connection with the subject of contracts, is the definition of a contract. In paragraph four of the introduction you will find about as good a definition of a contract as you can find anywhere. It is as follows: "A contract is an agreement to do, or not to do, a particular thing."

"Walker's American Law" is a book that may be recommended on this subject. One cannot do any better for law reading than to buy "Walker's American Law." It goes into the fundamental principles of law more simply than Blackstone, and it is particularly applicable to this country. Now Walker gives several definitions of a contract. He says, "Writers have given various definitions of a contract, of which I shall quote but three. Blackstone says it is an 'agreement, upon sufficient consideration, to do or not to do a particular thing.' Powell says it is 'a transaction in which each party comes under an obligation to the other, and each reciprocally acquires a right to what is promised by the other.' The French definition, taken from the civil law, is, 'a convention by which one or more persons obligate themselves to one or more other persons, to give, or to do, or not to do something.'"

The contract marked "A" (page 17), it will be noted, starts out in the manner usual to all contracts. The first clause can be

committed to memory and used in the same form in any contract. After the words "and concluded" always insert, "in duplicate" or in "triplicate," or whatever it may be, according to the number of copies executed. You will always know then how many copies of a contract there are in existence, and in case of a suit the court can have such copy or copies produced in evidence to show up the meaning of any disputed illegible clause.

The contract which you are to draw up is with the University Contract Company for the building of a bridge across the Spokane River, in Spokane County, and should read like this: "This agreement made and concluded in duplicate this 25th day of July, 1904, by and between the University Contract Company of Seattle, incorporated under the laws of the State of Washington, party of the first part, and the Board of County Commissioners of Spokane County, State of Washington, party of the second part." That wording is probably as simple as any that can be gotten up for the opening clause of a contract.

It is very usual, as will be found in Form "B" (page 18), after the first statement of names, to designate the parties to the contract by some shorter term; thus the party of the first part in agreement "B" is thereafter referred to as the "Contractor," and the party of the second part, which is in this instance the Washington Western Railway Company, is thereafter designated the "Owner." Then, after reciting who the parties are and their places of residence, you will notice Contract "A" follows with a clause which should be a separate paragraph. You will see it in Form "B" (page 18), beginning "Witnesseth," which is the usual form for the second paragraph of almost every contract, and which is the form to be kept in mind. The second clause starts out with, "Witnesseth, that for and in consideration of the payments hereinafter mentioned the party of the second part agrees," etc.

One of the first things required in a contract is a consideration. If there is no consideration named, the contract will not be valid, so when there is no large consideration in money it is usual to put in there, "For and in consideration of the payment of 'onedollar' or 'fivedollars,'" or some small amount, so that there is a consideration stated, even if it is no more than one dollar; but if it is a contract of considerable size, and one in which several payments are to be made, then it is generally stated "For and in consideration of the payments hereinafter mentioned."

The other elements of a contract are, in the first place, the two or more parties to the contract. Very often we have a contract with three parties one of whom has to give assent or to approve of the contract between the other two.

The next item is the subject-matter of the contract which must be a lawful one, as of course any agreement to do an unlawful thing would of itself render the contract null and void.

Then comes the matter of agreement. The agreement must be a mutual understanding between the parties, and, of course, a party in signing the contract admits the understanding of all the clauses, so that makes it a mutual agreement by the voluntary signing of the contract by the parties.

The following data can be used and an entire contract "A" written out, filling in the blanks. In giving the names of the parties where either or both of them are incorporated be careful to state that it is a corporation, or that they are incorporated. In the bridge contract, have the name of the Contracting Company, where located and where incorporated; and then the "Board of County Commissioners of Spokane County." Fill in the next blank space, that the work is to be done according to the plans and specifications submitted, and is for the sub- and superstructure of a bridge. The location of the bridge can be filled in as being over the Spokane River, and it is to have two concrete piers as shown on plan "A." It is a very wise thing to write out — not only to recite that there is to be two concrete piers — but to write out and specify by letter or number on what drawing those piers are shown. All drawings and plans should be fastened to the contract or, preferably, signed by the parties to the contract, and thereby made a part of the contract itself. There is a steel span 300 feet in length shown on plan "B," and two approaches fifty feet in length shown on plan "C." The work is to be completed by January 1, 1905. As data for filling in these descriptions I have merely jotted down the bare items, but it would be well if there is any special thing in regard to the site of the bridge which should be specified to have it so stated in the contract. Of course the contractor is supposed to go and see the site and satisfy himself concerning all the conditions. The site may not be in condition to allow him to go ahead with his work, the road approaching may not be graded, or there may be some obstructions; therefore it would be well to state any particulars in regard to this, in order to avoid misunderstanding by

the parties. In a great many cases, if unavoidable delays come up, the contractor cannot be held for damages for the completion of the work at a certain time, unless there is some specific clause requiring him to pay damages for delays beyond a certain time, and stating also that he would be entitled to a bonus for the completion of the work if done in a shorter time than that specified in the contract. But a penalty referred to as "liquidated damages" is collectible. It is usual in a contract for a bridge to put in a date when the party will have the site ready for building the bridge, so then in that clause fill in that the site of the bridge is to be ready by August 1, 1904. The amount of the contract price is \$45,000. When writing in the amount in a contract, do not simply set it down in words, but always write in the amount in figures; for instance, if it is a matter of ten dollars, write the words ten dollars, putting the amount in figures in parentheses between, like this, Ten (10) Dollars. In case the "Ten" should become blurred, there will be no question, for the figures have been used as well. This contract is for the sub- and superstructure complete. Very often there is nothing paid to the contractor until the work is completed; but in large contracts the payments are usually made on monthly estimates by the engineer in charge. So we will make the first payment here \$10,000 on the delivery of the steel or material at the railroad station or at the site of the bridge. In addition to that, there will be monthly estimates on the work, and any balance that may be due will be paid on the completion and acceptance of the work.

The last clause is not very important, but in work of this kind it is usual to put in a clause that in case the site is not ready for the work a certain amount shall be paid on delivery of the iron work at the site; therefore "on Spokane River," can be filled in there. We will make the amount of the payment 25 per cent in case the site is not ready. Then the contract is closed up with the usual clause, "In witness whereof, we, the parties, have hereunto set our hands, the day and year above written." Then it must be signed by both parties, and for each party by some officer or official who is authorized to sign for it, usually by the president or vice-president, or by both the president and secretary of the company. In this case it would be the president of the Contract Company and the chairman of the Board of County Commissioners, and on the left-hand side there should be

a witness to each signature, so that in case of any dispute as to the signatures there will be a witness or witnesses to testify to them.

It is obligatory in the laws of some of the states, and customary in most all others, that a seal should be affixed to a contract. On a seal there is usually the name of the company or corporation, the date of incorporation, and the word "Seal." The seals should be imprinted on the contract over the signatures, after it is signed.

Before taking up the building contract, "B," it may be stated that Wait's "Engineering and Architectural Jurisprudence" is very complete in all details of bidding on work and making contracts, and I do not know of any work that is more valuable in this line, or that explains more fully the duties of the architect and engineer. Almost anything you want to know about such matters can be found "boiled down" under the different headings in the table of contents.

In taking up building contract "B," it is well to know that there is a contract published for buildings which is called the "Uniform Contract," and which is approved by the American Institute of Architects. The form that is reproduced here is probably taken almost verbatim from that.

In a building contract it is a good idea to make the contract in triplicate, one copy for the builder, one for the owner, and one for the architect.

The contract to be written out according to Form "B" will be dated February 16, 1905, and is between the Washington Western Railway Company, a corporation, and the University Contract Company, also a corporation. It is for the building of a station at Everett. The size of the building is to be 24 by 80, as shown on the plans numbered from 1 to 8 inclusive. The foundation is to be completed by April 1, 1905. The idea of inserting a date when the foundation is to be completed is that there is often a necessity for it, for the purpose of grading or laying tracks around the station that could not be done until the foundation is completed. There are often reasons why portions of such a contract must be completed by a certain time, so that other contractors may be able to perform their work.

The walls and the roof are to be completed by June 1, which allows the contractor who has the train shed or other outside work to build to get started on his contract. The entire building is to be completed by August 1. Add to paragraph 6: "Pro-

vided that, should any delay be occasioned by the owner, an equitable extension of the above times may be allowed."

Under clause 9 it will be seen that the contract price is to be \$9,600.00. The payments will be \$1,000.00 on the completion of the foundation, \$4,000.00 more on the completion of the walls and roof; and in the next clause it is provided that the final payment shall be made within 30 days after the contract is completed. With private owners it is usual to make this in a very short time, sometimes within 5 or 10 days, but with a railway company it is necessary to give them at least 30 days, and I believe the Northern Pacific requires 60 days in which to make final payment; but we will make the final payment here 30 days after completion. There are some blank lines under the 11th clause, in which should be recited what the owner shall do during the progress of the work in maintaining fire policies, and it is best to add: "This contract shall become of full force and effect upon the contractor furnishing the owner with a satisfactory bond in the sum of \$5,000.00, otherwise it shall be of no force or effect." The signatures are similar to those in contract "A." On the part of a railway company it is very usual that contracts have to be signed by several officials, sometimes the president or general manager and the secretary. So this can be signed Washington Western Railway Company by John Doe, President, and Richard Roe, Secretary.

For other ordinary forms of contracts there are given copies of some government contracts. In one sense they are not ordinary contracts, as they are contracts for special pieces of work, but on the other hand they were originally made on printed forms that the government uses in all cases.

Form D has the name of the Contract Company and the different clauses filled in, similar to what we have just discussed in "A" and "B". It might be said here, although it is a sad thing to say, that government contracts are the most unjust contracts that are made anywhere. It is sad that while it is partly true, as was said by Lincoln, that our government is a "government of the people, for the people, and by the people," yet the matter of contracts could not be worse under a monarchy, on account of the forms a contractor is obliged to sign, which are simply iron-clad rules in the government's favor. He has no redress except to appeal to the government itself, for if he goes into the Court of Claims in Washington, that is simply another

department of the same branch of the government, and it will decide against the contractor almost every time. In the last year or so, however, it has been made possible for the contractor, in sums under \$10,000, to bring suit into the United States Court.

It will be seen that the date has been filled in in "C," and also the name of the parties. The second clause commences "For and in consideration of the payments hereinafter specified," etc. Always remember this, so that in writing contracts and specifications with no books to refer to the usual form will be fixed in your mind.

This is simply a contract to construct and complete in all respects a wharf at the navy yard, in strict compliance with all the plans and specifications, etc. The Navy Department, instead of signing the plans and specifications, attaches them to the contract and makes the whole into a little book, and there are usually five copies signed.

Another thing which might be mentioned is the time specified in which to execute the work. This is ostensibly three months, but it takes practically 30 days for the contract to go from Seattle to Washington and be signed, so that ordinarily the contractor has in reality only two months in which to complete his work after he receives the signed contract. They often award a contract according to the shortest time in which it can be completed, and the man who will agree to complete the work in the shortest time will usually get the contract, other things being right. But the man who agrees to do the work in three months often overlooks the fact that it takes 30 days to get the contract signed and returned from Washington.

You will notice that the price is \$30,000, and that the contract provides that \$40 per lineal foot shall be added or deducted, as contemplated in the specifications. It is almost impossible to get this unit price fixed so that it is just to both parties, so it is usually fairest to leave it to be estimated by the engineer, at so much for cost, with the profit added.

The reason is that it might be necessary to add a piece to the wharf where the piles were 10 or 15 feet longer than the average, or a piece might be left off where the piles were much shorter than the average.

I think it is not necessary to go into any discussion of Form "D," as it is practically the same as the others I have given. Read it over carefully and compare with Forms "A" and "B."

FORM A.

Standard Bridge Contract.

This Agreement, Made and concluded this day of in the year of our Lord, 190.., by and between

.....
 Party of the First Part, and

..... County, State of

of the Second Part, Witnesseth, That for and in consideration of payments hereinafter mentioned to be made and performed by the said party of the Second Part, the said party of the First Part doth hereby covenant and agree to furnish all the materials and construct and finish in a good and workmanlike manner, and in accordance with the plans and specifications
, the for :.....

and to complete the work by the day of 190.., completion being contingent upon strikes, delays of carriers, and other delays unavoidable or beyond control.

The said Second Party hereby agrees to have the site ready for the erection of said on or before the day of, 190...

And the said party of the Second Part hereby agrees, upon the completion of said work as above specified, to pay to the party of the First Part the sum of Dollars for

Payments to be made in the following manner, viz.:
 Dollars on the delivery of the finished work at the nearest railroad to the site, and the balance Dollars on the completion of said work ready for

Provided: That in case said Second Party fail to have the site ready for said work by the date hereinbefore specified, said Second Party hereby agrees to pay said First Party eighty per cent of the contract price for said work on the delivery of the finished iron work at site.

In Witness Whereof, We, the parties, have hereunto set our hands, the day and year above written.

.....

FORM B.

Building Contract.

This Agreement, Made in duplicate the day of
, in the year one thousand nine hundred and
 by and between

 party of the first part (hereinafter designated the Contractor), and

 party of the second part (hereinafter designated the Owner),

WITNESSETH, That the Contractor, in consideration of the fulfillment of the agreements herein made by the Owner, agrees with the said Owner as follows:

First. The Contractor under the direction and to the satisfaction of
 Architects acting for the purposes of this contract as agents of the said Owner shall and will provide all the materials and perform all the work mentioned in the specifications and shown on the drawings prepared by the said Architects for the

 which drawings and specifications are identified by the signature of the parties hereto.

Second. The Architects shall furnish to the Contractor such further drawings or explanations as may be necessary to detail and illustrate the work to be done, and the Contractor shall conform to the same as part of his contract so far as they may be consistent with the original drawings and specifications referred to and identified, as provided in the *first section*.

It is mutually understood and agreed that all drawings and specifications are and remain the property of the Architects.

Third. No alterations shall be made in the work shown or described by the drawings and specifications, except upon a written order of the Architects, and when so made, the value of the work added or omitted shall be computed by the Architects, and the amount so ascertained shall be added to or deducted from the contract price. In the case of dissent from such award by either party hereto, the valuation of the work added or omitted shall be referred to three (3) disinterested Arbitrators, one to be appointed by each of the parties to this contract, and the third by the two thus chosen; the decision of any two of whom shall be final and binding, and each of the parties hereto shall pay one-half of the expense of such reference.

Fourth. The Contractor shall provide sufficient, safe and proper facilities at all times for the inspection of the work by the Architects or their authorized representatives. He shall, within twenty-four hours after receiving written notice from the Architects to that effect, proceed to remove from the grounds or buildings all materials condemned by them, whether worked or unworked, and to take down all portions of the work which the Architects shall by like written notice condemn as unsound or improper, or as in any way failing to conform to the drawings and specifications.

Fifth. Should the Contractor at any time refuse or neglect to supply a sufficiency of properly skilled workmen, or of materials of the proper quality, or fail in any respect to prosecute the work with promptness and diligence, or fail in the performance of any of the agreements herein contained, such refusal, neglect or failure being certified by the Architects, the Owner shall be at liberty, after days' written notice to the Contractor, to provide any such labor or materials, and to deduct the cost thereof from any money then due or thereafter to become due to the Contractor under this contract; and if the Architects shall certify that such refusal, neglect or failure is sufficient ground for such action, the Owner shall also be at liberty to terminate the employment of the Contractor for the said work, and to enter upon the premises and take possession, for the purposes of completing the work comprehended under this contract, of all materials, tools and appliances thereon, and to employ any other person or persons to finish the work, and to provide the materials therefor; and in case of such discontinuance of the employment of the Contractor he shall not be entitled to receive any further payment under this contract until the said work shall be wholly finished, at which time, if the unpaid balance of the amount to be paid under this contract shall exceed the expense incurred by the Owner in finishing the work, such excess shall be paid by the Owner to the Contractor, but if such expense shall exceed such unpaid balance, the Contractor shall pay the difference to the Owner. The expense incurred by the Owner as herein provided, either for furnishing materials or for finishing the work, and any damage incurred through such default, shall be audited and certified by the Architects, whose certificate thereof shall be conclusive upon the parties.

Sixth. The Contractor shall complete the several portions and the whole of the work comprehended in this Agreement, by and at the time or time hereinafter stated

 provided that

Seventh. Should the Contractor be obstructed or delayed in the prosecution or completion of his work by the act, neglect, delay or default of the Owner, or the Architects, or of any other contractor employed by the Owner upon the work, or by any damage which may happen by fire, lightning, earthquake or cyclone, or by the abandonment of the work by the employees through no default of the Contractor, then the time fixed for the completion of the work shall be extended for a period equivalent to the time lost by reason of any or all of the causes aforesaid; but no such allowance shall be made unless a claim therefor is presented in writing to the Architects within twenty-four hours of the occurrence of such delay. The duration of such extension shall be certified to by the Architects, but appeal from their decision may be made to arbitration, as provided in the *third* section of this contract.

Eighth. The Owner agrees to provide all labor and materials not included in this contract in such manner as not to delay the material progress of the

work, and in the event of failure so to do, thereby causing loss to the Contractor, agrees that he will reimburse the Contractor for such loss; and the Contractor agrees that if he shall delay the material progress of the work so as to cause any damage for which the owner shall become liable (as above stated), then he shall make good to the owner any such damage. The amount of such loss or damage to either party hereto shall, in every case, be fixed and determined by the Architects or by arbitration, as provided in the *third* section of this contract.

Ninth. It is hereby mutually agreed between the parties hereto that the sum to be paid by the Owner to the Contractor for said work and materials shall be \$.....

subject to additions and deductions as hereinbefore provided, and that such sum shall be paid in current funds by the Owner to the Contractor in installments, as follows :

.....

The final payment shall be made within days after this contract is fulfilled.

All payments shall be made upon written certificates of the Architects to the effect that such payments have become due.

If at any time there shall be evidence of any lien or claim for which, if established, the Owner of the said premises might become liable, and which is chargeable to the Contractor, the Owner shall have the right to retain out of any payment then due or thereafter to become due an amount sufficient to completely indemnify him against such lien or claim. Should there prove to be any such claim after all payments are made, the Contractor shall refund to the Owner all moneys that the latter may be compelled to pay in discharging any lien on said premises made obligatory in consequence of the Contractor's default.

Tenth. It is further mutually agreed between the parties hereto that no certificate given in payment made under this contract, except the final certificate or final payment, shall be conclusive evidence of the performance of this contract, either wholly or in part, and that no payment shall be construed to be an acceptance of defective work or improper material.

Eleventh. The Owner shall, during the progress of the work, maintain full insurance on said work, in his own name and in the name of the Contractor, against loss or damage by fire. The policies shall cover all work incorporated in the building, and all materials for the same in or about the premises and shall be made payable to the parties hereto, as their interest may appear.

.....

Twelfth. The said parties for themselves, their heirs, executors, administrators and assigns, do hereby agree to the full performance of the covenants herein contained.

In Witness Whereof, the parties to these presents have hereunto set their hands the day and the year above first written.

In presence of

.....

FORM C.

NAVY DEPARTMENT.

Contractor's Copy of Contract No. 1006.

This Contract, made and concluded at Washington, D.C., this 14th day of August, A.D. 1902, by and between the University Contract Company, of Seattle, acting for itself, its successors and legal representatives, party of the first part, and the United States, by Mordecai T. Endicott, Chief of Bureau of Yards and Docks, Navy Department, acting under the direction of the Secretary of the Navy, party of the second part,

WITNESSETH, That for and in consideration of the payments hereinafter specified, the party of the first part hereby covenants and agrees to and with the party of the second part as follows, viz.:

First. That said party of the first part will provide, furnish and deliver, at its own risk and expense, at the United States Navy Yard, Puget Sound, Bremerton, Washington, all the necessary materials, labor, tools, and appliances for the construction and completion in all respects, of a wharf at said navy yard, and will construct and complete the same within three (3) calendar months from the date of this contract, in strict accordance with, and subject to, all the conditions and requirements of the plans and specifications appended hereto, and forming a part hereof, and of memorandum also appended, for the sum of thirty thousand dollars (\$30,000): *Provided*, That forty dollars (\$40) per linear foot shall be added or deducted for additions or deductions as contemplated in Item 4, Paragraph 96, of said specifications.

And this contract further WITNESSETH,

Second. That the party of the second part, for and in consideration of the foregoing, and for and in consideration of the faithful performance of this contract by the party of the first part, duly certified to by the inspecting officer appointed for that purpose, and the acceptance of the work as satisfactory on the part of the United States, hereby covenants and agrees, to and with the party of the first part, that there shall be paid to the said party of the first part, for the full and entire completion of the said wharf, the sum of thirty thousand dollars (\$30,000): *Provided*, That forty dollars (\$40) per linear foot be added or deducted for additions or deductions as contemplated in Section 4, Paragraph 96, of said specifications, upon approved bills certified and drawn in the usual manner, and payable through such navy pay office as the party of the first part may elect, within ten days after warrants for the same shall have passed by the Secretary of the Treasury in the following manner, viz.: As provided in paragraph twenty-eight of the specifications aforesaid.

Third. That it is mutually understood and agreed that no payment to said party of the first part will or shall be made by the United States for or on account of this contract, except those payments herein specified, and that, when not otherwise specifically provided, ten per cent will be withheld from the amount of each of such payments as security for the full completion and performance of the covenants and agreements hereof by the said party of the first part, and that the final payment made hereunder shall include the amounts so withheld.

Fourth. That it is further mutually and expressly covenanted and agreed, and this contract is upon the express condition that no member of or delegate to Congress, nor any officer of the United States, naval, military, or civil, is, or shall be, admitted to any share or part of this contract, or to any benefit to arise therefrom; and that any transfer of this contract, or of any interest therein, to any person or party by the said party of the first part, shall annul this contract so far as the United States is concerned.

In Witness Whereof, the said parties hereto have hereunto set their hands and seals the day and year first above written.

Signed and sealed in the
presence of

JOHN JONES,

JOHN SMITH.

UNIVERSITY CONTRACT COMPANY,
John Doe, Pres. and Gen. Mgr.

THE UNITED STATES,
By MORDECAI T. ENDICOTT,
*Chief of Bureau of Yards and Docks,
Acting under the direction of the
Secretary of the Navy.*

FORM D.

WAR DEPARTMENT CONTRACT.

(To be used when the specifications DO NOT call for liquidated damages.)

1. **This Agreement** entered into this thirteenth (13th) day of May, nineteen hundred and one, between John Millis, Major, Corps of Engineers, United States Army, of the first part, and University Contract Company, of Seattle, in the county of King, State of Washington, of the second part, *Witnesseth*, That, in conformity with the advertisement and specifications hereunto attached, which form a part of this contract, the said John Millis, Major, Corps of Engineers, for and in behalf of the United States of America, and the said University Contract Company, do covenant and agree, to and with each other, as follows:

That the said University Contract Company shall dredge a channel from deep water in Shilshole Bay, Puget Sound, through Salmon Bay for a distance of about six thousand (6,000) feet, subject to all the conditions of the specifications and of their proposal.

That the said John Millis, Major, Corps of Engineers, U. S. Army, for and in behalf of the United States of America, shall pay the said University Contract Company for such dredging, fifty cents (50c) per cubic yard.

2. All materials furnished and work done under this contract shall, before being accepted, be subject to a rigid inspection by an inspector appointed on the part of the Government, and such as do not conform to the specifications set forth in this contract shall be rejected. The decision of the engineer officer in charge as to quality and quantity shall be final.

3. The said University Contract Company shall commence the work herein contracted for within thirty (30) days after date of notification of approval of the contract by the Chief of Engineers, U. S. Army, and shall

complete the same within five (5) calendar months from such date of commencement.

4. If, in any event, the party of the second part shall delay or fail to commence with the delivery of the material or the performance of the work on the day specified herein, or shall, in the judgment of the engineer in charge, fail to prosecute faithfully and diligently the work in accordance with the specifications and requirements of this work contract, then, in either case, the party of the first part, or his successor legally appointed, shall have power, with the sanction of the Chief of Engineers, to annul this contract by giving notice in writing to that effect to the party (or parties, or either of them) of the second part, and upon the giving of such notice all payments to the party or parties of the second part under this contract shall cease, and all money or reserved percentage due or to become due the said party or parties of the second part, by reason of this contract, shall be retained by the party of the first part until the final completion and acceptance of the work herein stipulated to be done; and the United States shall have the right to recover from the party of the second part whatever sums may be expended by the party of the first part in completing the said contract in excess of the price herein stipulated to be paid the party of the second part for completing the same, and also all costs of inspection and superintendence incurred by the said United States in excess of those payable by the United States during the period herein allowed for the completion of the contract by the party of the second part; and the party of the first part may deduct all the above mentioned sums out of or from the money or reserved percentages retained as aforesaid; and upon the giving of the said notice the party of the first part shall be authorized, if an immediate performance of the work or delivery of the materials be in his opinion required by the public exigency, to proceed to provide for the same by open purchase or contract, as prescribed in section 3709 of the Revised Statutes of the United States: *Provided, however,* That if the party (or parties) of the second part shall by epidemics, freshets, ice, local or other state quarantine restrictions, force or violence of elements, or other unavoidable cause of delay, and by no fault of his or their own be prevented either from commencing or completing the work, or delivering the materials at the time agreed upon in this contract, such additional time may, with the prior sanction of the Chief of Engineers, be allowed him or them, for such commencement or completion, as, in the judgment of the party of the first part, or his successor, shall be just and reasonable; but such allowances and extension shall in no manner affect the rights or obligations of the parties under this contract, but the same shall subsist, take effect, and be enforceable precisely as if the new date for such commencement or completion had been the date originally herein agreed upon.

5. It is further expressly understood and agreed that in case of failure on the part of the party of the second part to complete this contract as specified and agreed upon, the said United States shall have the right to recover from the party of the second part all cost of inspection and superintendence incurred by the said United States during the period of delay, and also whatever sums may be expended by the party of the first part in completing the said contract in excess of the price herein stipulated to be paid to the party of the second part for completing the same. And the said party of the first part may deduct

or retain all the above-mentioned sums out of or from any money or reserved percentage that may be due or become due the party of the second part under this agreement.

6. If at any time during the prosecution of the work, it may be found advantageous or necessary to make any change or modification in the project, and this change or modification should involve such change in the specifications as to character and quantity, whether of labor or material, as would increase or diminish the cost of the work, then such change or modification must be agreed upon in writing by the contracting parties, the agreement setting forth fully the reasons for such change, and giving clearly the quantities and prices of both material and labor thus substituted for those named in the original contract, and before taking effect must be approved by the Secretary of War: *Provided*, That no payments shall be made unless such supplemental or modified agreement was signed and approved before the obligation arising from such modification was incurred.

7. No claim whatever shall at any time be made upon the United States by the party or parties of the second part for or on account of any extra work or material performed or furnished, or alleged to have been performed or furnished under or by virtue of this contract, and not expressly bargained for and specifically included therein, unless such extra work or materials shall have been expressly required in writing by the party of the first part or his successor, the prices and quantities thereof having been first agreed upon by the contracting parties and approved by the Chief of Engineers.

8. The party of the second part shall be responsible for and pay all liabilities incurred in the prosecution of the work for labor and material.

9. It is further agreed by and between the parties hereto that until final inspection and acceptance of, and payment for, all of the material and work herein provided for, no prior inspection, payment, or act is to be construed as a waiver of the right of the party of the first part to reject any defective work or material or to require the fulfillment of any of the terms of the contract.

10. The party of the second part agrees to hold and save the United States harmless from and against all and every demand, or demands, of any nature or kind for, or on account of, the use of any patented invention, article, or process included in the materials hereby agreed to be furnished and work to be done under this contract.

11. Payments shall be made to the said University Contract Company, monthly, when the work contracted for shall have been accepted during the month, reserving twenty (20) per cent from each payment until the whole work shall have been accepted.

12. Neither this contract nor any interest therein shall be transferred to any other party or parties, and in case of such transfer the United States may refuse to carry out this contract with the transferrer or the transferee, but all rights of action for any breach of this contract by said University Contract Company are reserved to the United States.

13. No member of or delegate to Congress, nor any person belonging to, or employed in, the military service of the United States, is or shall be admitted to any share or part of this contract, or to any benefit which may arise herefrom.

But this stipulation so far as it relates to member of or delegates to Congress, is not to be construed to extend to this contract.

14. This contract shall be subject to approval of the Chief of Engineers, U. S. Army.

In Witness Whereof, the parties aforesaid have hereunto placed their hands the date first above written.

Witness:

JOHN JONES, as to	{	JOHN MILLIS,
JOHN SMITH, as to		Major, Corps of Engineers.
		UNIVERSITY CONTRACT CO.,
		JOHN DOE, Pres. and Gen. Mgr.

Executed in Quintuplicate

Approved: May 28, 1901.

G. S. GREESPIN.

FORM E.

Standard County Form of Contract.

This Agreement, made and entered into in duplicate, this day of in the year one thousand nine hundred and by and between party of the first part (hereinafter designated the Contractor), and County, in the State of Washington, party of the second part (hereinafter designated the Owner),

WITNESSETH, That the Contractor, being the said part..... of the first part, in consideration of the covenants and agreements herein contained on the part of the Owner, being the said party of the second part, do covenant, promise and agree with the said Owner, in manner following, that is to say:

First. The Contractor shall and will well and sufficiently perform and finish, under the direction, and to the satisfaction of the Board of County Commissioners of County, Washington, all the work included in the

Second. Should it appear that the work hereby intended to be done, or any of the matters relative thereto, are not sufficiently detailed or explained, the Contractor shall apply to the Owner for such drawings or explanations as may be necessary, and shall conform to the same as part of this contract.

Third. Should any alterations be required in the work, a fair and reasonable valuation of the work added or omitted shall be made by mutual agreement, and the sum herein agreed to be paid for the work shall be increased or diminished as the case may be.

Fourth. The Contractor shall, within twenty-four hours after receiving written notice from the Owner to that effect, proceed to remove from the grounds or premises all materials condemned by the Owner, whether worked or unworked; or take down all portions of the work which the Owner shall condemn as unsound or improper. The Contractor shall cover, protect, and exercise due diligence to secure the work from injury, and all damage happening to the same by neglect shall be made good by

Fifth. The Contractor shall permit the Owner, and all persons appointed by the Owner, to visit and inspect the said work, or any part thereof, at all times and all places during the progress of the same, and shall provide sufficient, safe and proper facilities for such inspection.

Sixth. The Contractor shall and will proceed with said work, and every part and detail thereof, in a prompt and diligent manner, and shall and will wholly finish the work according to this contract, on or before the day of in the year one thousand nine hundred and, and in default thereof, the Contractor shall pay to the Owner Dollars for every day thereafter that the said work shall remain unfinished, as and for liquidated damages, the same to be retained from any sum or sums due or to become due the Contractor from the Owner on account of this or any other contract.

Seventh. Should the Contractor be obstructed or delayed in the prosecution or completion of the work by the neglect, delay or default of any other contractor; or by an alteration which may be required in the said work; or by any damage which may happen thereto by fire, or by the unusual action of the elements, or otherwise; or by the abandonment of the work by the employees through no fault of the Contractor, then there shall be an allowance of additional time beyond the date set for the completion of the said work; but no such allowance shall be made unless a claim is presented in writing at the time of such obstruction or delay. The Owner shall ascertain the amount of additional time to be allowed; in which case the Contractor shall be released from the payment of the stipulated damages for such additional time, and no more.

Eighth. The Contractor shall not let, assign or transfer this contract, or any interest therein, without the written consent of the Owner.

Ninth. The Contractor shall make no claim for additional work unless the same shall be done in pursuance of a written order from the Owner, and notice of all claims shall be made to the Owner in writing within ten days of the beginning of such work.

Tenth. Should the Contractor at any time refuse or neglect to supply a sufficiency of properly skilled workmen, or of materials of the proper quality, or fail in any respect to prosecute the work with promptness and diligence, or fail in the performance of any of the agreements on part herein contained, such refusal, neglect or failure being ascertained by the Owner, said Owner shall be at liberty, after three days' written notice to the Contractor, to provide any such labor or materials, and to deduct the cost thereof from any money then due or thereafter to become due to the Contractor under this contract; and if the Owner shall find that such refusal, neglect or failure is sufficient ground for such action, the Owner shall also be at liberty to terminate

the employment of the Contractor for the said work and to enter upon the premises and take possession of all materials thereon, and to employ any other person or persons to finish the work, and to provide the materials therefor; and in case of such discontinuance of the employment of the Contractor he shall not be entitled to receive any further payment under this contract until the work shall be wholly finished, at which time, if the unpaid balance of the amount to be paid under this contract shall exceed the expense incurred by the Owner in finishing the work, and all demurrages which shall have occurred under the terms of this contract, such excess shall be paid by the Owner to the Contractor, but if such expense and demurrage shall exceed such unpaid balance, the Contractor shall pay the difference to the Owner. The expense incurred by the Owner as herein provided, either for furnishing materials or for finishing the work, and any damages incurred through such default, shall be ascertained by the Owner, whose decision thereon shall be conclusive upon the parties.

Eleventh. And it is hereby mutually agreed between the parties hereto that the sum to be paid by the Owner to the Contractor for said work and materials shall be

.....
 subject to additions or deductions on account of alterations or demurrages as hereinbefore provided, and that such sum shall be paid in Warrants on the Fund of County by the Owner to the Contractor, as follows:

.....

 It being understood that the final payment shall be made within days after this contract is completely finished and accepted; provided, that in each of the said cases the Contractor shall give the Owner good and sufficient evidence that the (Road or Bridge) is free from all liens and claims chargeable to the said Contractor; and further, that if at any time there shall be any lien or claim for which, if established, the Owner or the said (Road or Bridge) might be made liable, and which would be chargeable to the said Contractor, the Owner shall have the right to retain out of any payment then due or thereafter to become due said Contractor an amount sufficient to completely indemnify it against such lien or claim, until the same shall be effectually satisfied, discharged or canceled. And should there prove to be any such claim after all payments are made, the Contractor shall refund to the Owner all moneys that the latter may be compelled to pay in discharging any lien on said premises, made obligatory in consequence of the former's default.

Twelfth. It is further mutually agreed between the parties hereto that no certificate given or payment made under this contract, except the final certifi-

cate or final payment, shall be conclusive evidence of the performance of this contract, either wholly or in part, against any claim of the Owner, and no payment shall be construed to be an acceptance of any defective work.

Thirteenth. And the said Owner hereby promises and agrees with the said Contractor to employ, and does hereby employ said Contractor to provide the materials and do the said work according to the terms and conditions herein contained and referred to, for the price aforesaid, and hereby contracts to pay the same at the time, in the manner and upon the conditions above set forth.

Fourteenth. And the said party of the first part, for heirs, executors, administrators and assigns, and the said party of the second part, for itself, its successors and assigns, hereby agree to the full performance of the covenants herein contained.

.....

.....

In Witness Whereof, the parties to these presents have hereunto set their hands, the day and year first above written.

In presence of

.....

.....
 County,
 In the State of Washington.
 By
 Chairman of its Board of County
 Commissioners.

Attest:

.....
 County Auditor.

.....

Standard Contract of Large Railroad Company.

Date. **Agreement,** Made and entered into this Fourth day of January, 1908, between Western Construction Company, a corporation, organized and existing under and by virtue of the laws of the State of Nevada, with its principal place of business at Seattle, King County, Washington, hereinafter called the "Contractor,"

Parties. party of the first part, and the Puget Sound Railway Company, a corporation, hereinafter called the "Company," party of the second part, **WITNESSETH:**

Work and Location. The Company proposes to have riprap placed alongside its temporary bridge south of Everett; also alongside of its bridge Number 6, North of Seattle.

Covenant. The Contractor, for the consideration hereinafter named, agrees to furnish all labor, tools, apparatus and material necessary to place said riprap alongside said bridges, as directed by the Chief Engineer of the Company, or his authorized assistants.

No alterations or additions shall be made in the work shown **Alterations.** and described in said plans and specifications except upon the written order of the Chief Engineer of the Company, and, when so made, the value of the work added or omitted shall be computed by said Chief Engineer, or his representatives, unless previously agreed upon in writing by the parties hereto; and the amount so ascertained shall be added to or deducted from the contract price. The decision of the Chief Engineer of the Company as to the value of the work added or omitted shall be conclusive upon the parties.

The Contractor shall commence said work on or before the *Fifteenth* day of January, 1908, and shall complete the same on or before the *First* day of May, 1908. **Date Commencement and Completion.**

Time is material and of the essence of this contract. No extension of time within which to complete the same shall be granted to the Contractor for any cause whatever, unless the same is made necessary by the fault of the Company, by the act of God, by inevitable accident, or by strikes of the employees of the Contractor, in which case the Chief Engineer of the Company may, in writing, extend such time. The period of such extension so made necessary shall be certified by said Chief Engineer and shall be conclusive upon the parties. **Extension of Time.**

The Contractor shall and will carry on and prosecute the said work in its several parts and branches in such manner, at such times, and in such places as the Company may from time to time direct. **Work When and Where Directed.**

The Company shall have the right, whenever in its opinion it is necessary or expedient for it to so do, to stop said work or any part thereof or reduce the force employed thereon; and the Contractor shall have no claim for damages by reason thereof, but shall stop the work or reduce the force as the Company may in writing direct, and in such case shall be paid a reasonable compensation based on contract price, amount of work done and expenses incurred. Said writing shall be signed by said Chief Engineer and delivered to the Contractor or to some person representing him on the work at least *three* days prior to such stoppage of work or reduction of force. **Stopping Work.**

In case the Contractor shall at any time refuse or neglect to supply a sufficient number of properly skilled workmen, or a sufficient quantity of material of the proper quality for said work, or fail, in any respect, to prosecute said work with promptness and diligence, or fail in the performance of any of the covenants herein stipulated to be performed by the Contractor, the Company may, at its option, after three days' notice to the Contractor provide all such labor and materials, and deduct the cost thereof from any moneys then due or thereafter to become due to the Contractor under this contract. If in the opinion of the Chief Engineer of the Company such failure, neglect or refusal shall be sufficient grounds for such action, the Company shall be at liberty **Promptness.**

**Power to
Cancel.**

to terminate this contract and to enter upon the premises, and, for the purpose of completing the work herein mentioned, take possession of all materials, tools and appliances thereon, and employ any other person or persons to finish said work, and provide the materials therefor. In such case the Contractor shall not be entitled to receive any further payment under this contract until said work shall be wholly finished, at which time if the unpaid balance of the amount to be paid hereunder shall exceed the expense incurred by the Company in finishing said work, such excess shall be paid to the Contractor; but if the said unpaid balance shall be less than the expense of completing said work, the Contractor shall pay to the Company the amount of such deficit. The expenses incurred by the Company, either for furnishing materials or finishing said work, and any damage incurred by it through such default, failure or refusal, shall be certified by the Chief Engineer of the Company, whose certificate shall be conclusive upon the parties hereto.

**Unpaid
Balance.****Claims for
Labor and
Material.**

The Contractor shall pay and discharge all claims for labor and material furnished to him for said work, and shall protect the Company from liens therefor. The Company may from time to time pay any such claims arising in favor of any person against the Contractor, and may retain and deduct from the amounts due to the Contractor, and as they become due under this contract, the sums so paid in settlement and discharge of such claims. The receipts of the persons holding such claims shall be equivalent to the receipts of the Contractor.

Liens.**Inspection.**

Said work shall at all times during the progress thereof be subject to the supervision of the Chief Engineer of the Company, or of such persons as he shall delegate. The Contractor shall provide sufficient, safe and proper facilities at all times for the inspection of the work hereunder, and of the material to be used therein, by said Chief Engineer or his representatives; and shall within twenty-four (24) hours after receiving written notice from said Chief Engineer or his representatives to that effect proceed to remove from the grounds and premises, and from said work, all materials condemned by him, whether worked or unworked, and to take down all portions of the work which said Chief Engineer shall condemn, or which, in any manner, shall fail to conform to such plans and specifications.

**Removal of
Condemned
Material.****Removal of
Faulty Work.****No Liquor.**

The Contractor shall not or will not permit to be brought, drunk or used on the line of railroad of the Company or at or near said work any intoxicating liquor or beverage of any description; shall not and will not do or suffer his employees to do any damage to crops or other property at or adjacent to said work, and shall and will, upon the direction of the Company, discharge any foreman or other employee engaged in said work who shall in the opinion of said Chief Engineer be disorderly, intemperate, incompetent, negligent or dishonest.

**Damage to
Property.****Disorderly
and Negligent
Workmen.**

In case any dispute shall arise between the parties hereto as to the interpretation of this contract, or the plans and specifications herein referred to, the decision of the Chief Engineer of the Company as to such interpretation of said contract, plans and specifications, shall be conclusive upon the parties hereto. **Arbitration.**

No certificate given or payment made under this contract shall be evidence of the performance of the same, either in whole or in part, and no payment shall be construed as an acceptance of defective work or improper materials. **Payment not Acceptance.**

The Company shall and will furnish free transportation over its own lines of railway for men *between* Seattle and Everett necessary to be employed or used in said work. The necessity for such transportation shall be in each case certified by said Chief Engineer, and his certificate shall be conclusive. **Transportation.**

It is further mutually agreed between the parties hereto that the Company, in the transportation of any men, tools or materials herein agreed to be transported free, shall be deemed to be a private carrier without hire and not otherwise, and the Contractor expressly agrees that the Company shall not be liable to him while riding free as aforesaid, for any personal injury to himself nor for any loss or damage to his tools or materials transported free as aforesaid. **Contractors' Assumption of Liability.**

The Contractor further agrees that he will cause each and every person employed by him in the work before mentioned and who shall be transported free as aforesaid, to execute an agreement to the effect that the Company, in such transportation, shall be deemed to be a private carrier without hire and not otherwise, and that the Company shall not be liable to said employee for personal injury received by him while riding free as aforesaid, nor for any loss or damage to his tools or other property transported free. In the event of failure of the Contractor to cause the persons employed by him to execute such an agreement he shall indemnify the Company and save it harmless from loss or damage on account of any claim made by such persons for personal injuries or damage to property suffered by them while being transported free as aforesaid.

The Contractor in the prosecution of the work hereunder shall be and is an independent contractor, and shall be solely liable for any and all injuries to persons or damage to property, in any manner caused by the negligence of the Contractor, his agents or servants, in or about the prosecution of the work covered by this contract, and shall indemnify and save harmless the Company from any and all loss or damage on account of any such injuries to persons or damage to property. **Independent Contractor.**

The Contractor in the prosecution of the work covered hereby shall so conduct the same as not to interfere with the movement of trains or traffic upon and over the tracks of the Company at and adjacent to the site of said work, and shall so arrange and conduct operations in said work as to permit said trains to pass continuously and safely upon and over said tracks. **No Interruption of Traffic.**

**Sub con-
tracts.**

The Contractor shall not assign or sublet this contract without the written consent of said Chief Engineer.

Payment.

In consideration of the Contractor doing the work hereinbefore described, in the manner and within the time specified, the Company shall pay to the Contractor therefor as follows, to wit:

Rock dumped in place, per cubic yard, \$1.75. Measurements to be made on scows at site of work; contractors to load the rock on scows uniformly, so as to aid in proper measurements of the material furnished. No rock shall be furnished smaller than 8 or 10 inches, the bulk of it to be large as handling will permit. Estimates to be made at the end of each month and a payment of eighty-five (85) per cent of said estimate to be made on or before twenty (20) days thereafter; final payment to be made twenty (20) days after the completion of the work and its acceptance by the Chief Engineer of the Company.

In Witness Whereof, the parties hereto have caused this agreement to be duly executed the day and year first hereinabove written.

In presence of

J. S. MASON,

C. H. PARK.

{	WESTERN CONSTRUCTION COMPANY,
	<i>By John Doe, Pres.</i>
	PUGET SOUND RAILWAY COMPANY,
	<i>By James Roe, 2d Vice-Pres.</i>

CHAPTER III.

ORDINARY SPECIFICATIONS.

THE International Dictionary defines "specification" as "A written statement containing a minute description or enumeration of particulars."

But that is rather abstruse and does not explain as fully as might be wished, what a person would want to make a specification cover; so I have formulated a definition of my own that covers the "engineering specification" more fully. It is as follows:

"A concise, accurate, and detailed description of the work or structure to be built, together with a concise, accurate, and detailed description of the materials and their method of fabrication and, to some extent, of the methods of construction of the work or structure."

The last thing mentioned, that is, the methods of construction of the work, or methods of doing the work, should not be too detailed or specific. It is not desirable always to state the methods or to hold the contractor down to doing the work in a certain or particular way. He should be allowed a certain discretion in the matter, and it is not desirable to describe the method any further than is actually necessary.

In taking up some of the forms of specifications my own "General Specifications for Steel Roofs and Buildings" are used on account of my greater familiarity with its details.

In writing specifications, first divide the subject into general heads, enumerating the various things which are to be covered by the specifications, or, in other words, make a sort of synopsis of the work to be done under them.

The first clause in the general headings is the "General Description," followed by Unit Strains, Plate Girders, Corrugated Iron, Ventilation, Lighting, Details of Construction, Workmanship, Quality of Material (which should be subdivided into wrought iron, steel, and timber), then should follow paragraphs for Painting and Erection.

Very seldom would there be any other general headings than those enumerated.

In using a general specification for any particular structure, the description must be very minutely and accurately given in a detailed specification to accompany the general one. Having the general heads to cover the various portions of the work, subdivide them.

For example, under the head of loads, there is the snow load, the wind load, the weight of the covering, the weight of the ceiling, weight of the trusses, etc.

In getting up this building specification, there was found to be nothing published in regard to the actual snow load, the same fixed amount per square foot being assumed for all localities. Specifications also usually give a fixed amount for the snow load, whether the structure is to be located in the tropics or in the arctic regions.

Of course, for any particular piece of work the snow load can be stated as given in the Table, according to the place where the roof happens to be located. Then there is the wind pressure for the roof itself to be considered, which is practically the same in all standard specifications or books. The pressure on the sides and ends of a building, due to wind loads, had never been fixed until given in this specification.

For each particular building the exact weight of the covering can be specified. Corrugated iron is usually specified according to its thickness or gauge, such as No. 20, No. 22, etc. But these gauges are very elastic; therefore it is better to specify not only the gauge but the weight of the corrugated iron to be put on a building, that is, specify the exact weight per square foot.

The matter of the weight of trusses can be figured exactly for any particular roof, although the formulas given here will work out close enough for practical purposes.

Paragraph 10 is one that should be taken account of whenever a building is to be erected for milling or mining purposes: "Mill buildings, or any that are subject to corrosive action of gases, shall have all the above loads increased 25 per cent."

Under the head of unit strains you will notice that the grade of steel adopted is soft medium steel, and since this was written originally many other specifications have been changed to cover this grade.

A special division has been given to Plate Girders for the reason that they are not always used in buildings, but it seemed advisable to give a specification for them.

In regard to the corrugated iron covering you will notice that is gone into fully, as to the size of the corrugations, weight, the gauge to be used, etc.

The next section takes up ventilation, merely as deduced from practice. In the matter of louvers, I want to call the reader's attention to the manner in which they are made. They are often made out of pieces of sheet iron with bent or flanged edges, or sometimes with a curled edge. The object of making the curl is to strengthen or stiffen it and to make it carry over a longer span. The one I generally use is simply corrugated, one that can be turned out by any manufactory of corrugated iron. It is cheap and stiff.

In the matter of lighting, the paragraph which is given to that is simply a practical statement. I do not know that there is any scientific way of getting at any particular amount of light for a building. Years ago buildings were constructed very badly in this respect, and had comparatively little natural light, so that on dark days, or early in the afternoon of short winter days, there would be practically no light at all. Now buildings are constructed sometimes so that the sides are nearly all windows.

In this specification, "Details of Construction" are practically the same as given in a bridge specification, which is also true of "Workmanship."

With reference to "Quality of Materials," I have already explained that, as regards steel, the specification covers soft medium steel for all main members. Wrought iron is covered because a great many rods and rivets used to be made of that material, whereas soft steel is now generally used. It is now possible to get all material of steel that will answer every requirement.

In the matter of painting, this specification is different from the ordinary bridge specification, owing to the fact that it calls for lead paint. In ordinary cases it is just as well to use ordinary lead paint of good quality, although red-lead paint is very much better in some special cases.

Cooper's "Specification for Steel Railroad Bridges" comes next



on the list, and it is probably the best general specification of its kind that is published; also it was about the first that was ever gotten out. Cooper has kept it right up to date, and whenever there has been any change in the quality or class of materials used, this has been changed also; so that his 1906 edition represents the very latest things in bridge work. It is also the best elementary treatise on bridge work, I think, that has ever been written. Cooper's specifications have the merit, as well, of being extremely simple.

Under the head of "General Description," the principal thing to be noted is the different types of bridges specified for various lengths. It was the idea of engineers fifteen years ago that riveted trusses could not be constructed at any reasonable cost beyond 120 feet in length, but Cooper gives the limit as 150 feet for present-day practice. I was told years ago by Mr. George H. Thomson, at one time bridge engineer for the New York Central and Hudson River Railroad, who had wide experience along that line, that riveted trusses can be constructed up to 200 feet span or over as cheap or cheaper than pin connected, and my own experience during the past ten years has verified this statement.

The compound Warren truss is one that was used by the Union Bridge Company in building the K. and I. Bridge at Louisville, Ky., and it is a very good type of truss for a riveted structure. Some of the bridge companies use the multiple system of trussing for riveted work.

It will be noted that the "General Description" given in Cooper is quite extensive.

About the division of "Loads," page 4, paragraph 23, it may be said that Cooper's loadings are perhaps the most used of any that are specified in a general specification, for the reason that it is a very simple and very uniform system of loading. Waddell's is practically the same in get-up, but does not fit actual conditions so well for the different railways as Cooper's does. Of course, each of the big railway lines has a loading of its own, with the idea that it is getting exactly at the weight of the trains that are running over the bridges every day; but while a railroad may have a particular type of locomotive this year, it is liable to change to an entirely different class another year, so that the actual loading does not fit the

bridges well at all; therefore in going over a calculation of stresses of a number of bridges on the same road for any particular loading it will be found that hardly any two bridges are just right for the loading.

The wind loads specified by Cooper have become the practical standard of the world, and are used the world over for railroad bridges, as are also his wind loads for highway bridges.

The unit stresses for rivets and combined strains given on pages 10 and 11 are just the ordinary ones that are used in the design of details for bridges. Use simply the various unit strains as they are set forth there.

In the matter of "Details of Construction" on page 12, it would be well to take up each clause and study it carefully, as it gives the best practice in the detailing of bridge work.

It will be noted that Cooper specifies that the steel must be made by the open-hearth process. He declined for many years to say what method of manufacture should be used, simply requiring it to come up to certain specifications as to strength; but he finally came to specify that all steel should be made by the open-hearth process, as Bessemer steel is not as uniform as that made by the open-hearth process. If going into steel construction as a business, the reader should not fail to get Howe's "Metallurgy of Steel" and study up this subject thoroughly. Probably 90 per cent of the structural steel manufactured now is made by the basic open-hearth method. It is a method that uses a very much larger proportion of scrap iron than others, but gives a better product. Cooper sticks to the old idea of using soft and medium steel, although 50 per cent of the railroads use soft medium steel; some still use medium steel for some parts and soft steel for other parts.

Wherever castings are to be used in bridges, it is very much better to use cast steel than cast iron. Cast iron is very brittle. Cast steel has higher tensile strength than rolled steel.

There is also a specification for timber, that is very short but one of the best.

The next section, page 25, speaks of inspectors and covers fully though briefly the matter of inspection of structures. The practice in late years has been for every railroad to have an inspector go to the mill and inspect the material there before it

goes into the structure, and to see that good material is placed in the bridge.

There are bureaus that furnish inspectors for all sorts of work, but the inspectors of these bureaus, when they are hired by a small railroad or a small concern, usually do the most service in making out their bills and do very little in the matter of inspection. They usually go to the shops, call on the general manager, get a good cigar, walk down through the shops, spend ten or fifteen minutes in looking around, and then catch the next train for home. If the reader ever has occasion to hire an inspector he should know who he is, for in nine cases out of ten it is money thrown away. Often better results are obtained by taking the test sheets of the mill and the reports of chemical composition.

On page 27 will be found "Final Tests of Bridges"; it is all right to have that in a specification, but I never considered such a test to amount to very much; that is, to have a test train run over the bridge. It is better to know what your material is and that the bridge is built well than to test it by having test trains run over it at full speed.

It is well to have Cooper's "Specifications for Foundations," although I cannot say that a general specification for a foundation is of very much use in letting a contract in actual practice. As a short treatise on foundations it will repay careful reading and study. The general specification takes up about twelve pages, and can be used as a guide, and as a guide only, in writing out a specification for any foundation that may be designed. I call attention to the headings only, as it is impossible to give any general description of foundations, because no two foundations are alike or even similar. When it comes to the matter of timber and piling, this is a specification that is good to use and incorporate in the special specification.

The matter of spikes is one that I never considered it necessary to make a specification for. The sizes should be shown on the drawings.

Cement should be gone into a great deal more fully than this specification does, and for any small work it is better to have actual tests made. For any large structure have a detailed specification for the cement work.

The specification for sand is the usual one. It is a fact,

however, that ordinary sand with some earth in it will often give stronger concrete than perfectly clean sand.

Cement, mortar, gravel, and broken stone are given, and then come the various classes of masonry.

Then we have a specification for steel shells for cylindrical and oblong piers.

The remainder of the specification is a "General Description of Substructures and Methods of Founding," which is valuable as a short treatise on foundations and for reference purposes when engaged in practical work.

General Specifications for Steel Roofs and Buildings.

BY CHARLES EVAN FOWLER.

GENERAL DESCRIPTION.

1. The structure shall be of the general outline and dimensions shown on the attached diagram, which gives the principal dimensions and all the principal data. (2, 72.) **Diagram.**

2. The sizes and sections of all members, together with the strains which come upon them, shall be marked in their proper places upon a strain sheet, and submitted with proposal. (1, 72.)

3. The height of the building shall mean the distance from top of masonry to under side of bottom chord of truss. The width and length of building shall mean the extreme distance out to out of framing or sheeting. **Clearances.**

4. The pitch of roof shall generally be one-fourth. (6.)

LOADS.

The trusses shall be figured to carry the following loads:

5. Snow loads.

Snow Load.

Location.	Pitch of Roof.				
	1-2	1-3	1-4	1-5	1-6
Southern States and Pacific Slope	0	0	0	0	0
Central States.....	0	7	15	22	30
Rocky Mountain States.....	0	10	20	27	35
New England States.....	0	10	20	35	45
Northwest States.....	0	12	25	37	50
Pounds per hor. sq. foot.					

**Wind
Load**

6. The wind pressure on trusses in pounds per square foot shall be taken from the following table:

Pitch.	Vertical.	Horizontal.	Normal.
1-2 = 45° 00'	19	19	27
1-3 = 33° 41'	17	12	22
1-4 = 26° 34'	15	8	18
1-5 = 21° 48'	13	6	15
1-6 = 18° 26'	11	4	13

7. The sides and ends of buildings shall be figured for a uniformly distributed wind load of 20 pounds per square foot of exposed surface when 20 feet or less to the eaves; 30 pounds per square foot of exposed surface when 60 feet to the eaves, and proportionately for intermediate heights. (6.)

**Weight of
Covering.**

8. The weight of covering may be taken as follows: Corrugated iron laid, black and painted, per square foot;

No. 27	26	24	22	20	18	16
.90	1.00	1.30	1.60	1.90	2.60	3.30 pounds.

For galvanized iron add 0.2 pounds per square foot to above figures.

Slate shall be taken at a weight of 7 pounds per square foot for 3-16" slate 6" x 12", and 8.25 pounds per square foot for 3-16" slate 12" x 24", and proportionately for other sizes.

Sheeting of dry pine boards at three pounds per foot board measure.

Plastered ceiling hung below at not less than 10 pounds per square foot.

The exact weight of purlins shall be calculated.

**Weight of
Trusses.**

9. The weight of Fink roof trusses up to 200 feet span may be calculated by the following formulæ for preliminary value.

$$w = .06 s + .6, \text{ for heavy loads.}$$

$$w = .04 s + .4, \text{ for light loads.} \quad (40, 45.)$$

$$s = \text{span in feet.} \quad w = \text{weight per hor. sq. ft. in pounds.}$$

**Increase of
Loads.**

10. Mill buildings, or any that are subject to corrosive action of gases, shall have all the above loads increased 25 per cent.

11. Buildings or parts of buildings subject to strains from machinery or other loads not mentioned, shall have the proper allowance made.

**Minimum
Load.**

12. No roof shall, however, be calculated for a less load than 30 pounds per horizontal square foot.

UNIT STRAINS.

		Soft Medium		
		Iron.	Steel.	
13.	Shapes, net section		15,000	(57.)
	Bars	14,000	17,000	Tension only.
	Bottom flanges of rolled beams.		15,000	
	Laterals of angles, net section ..		20,000	(57.)
	Laterals of bar	18,000		(41.)
14.	Flat ends and fixed ends	12,500	500 $\frac{l}{r}$	Compression Only.
l = length in feet c. to c. of connections.				
r = least radius of gyration in inches. (59.)				

15. Top flanges of built girders shall have the same gross area **Flanges.**
as tension flanges. (24.)

16. Members subject to transverse loading in addition to direct **Combined.**
strain, such as rafters, and posts having knee braces connected to
them, shall be considered as fixed at the ends in riveted work, and
shall be proportioned by the following formulæ, and the unit
strain in extreme fiber shall not exceed for soft medium steel 15,000.

$$S = \frac{Mn}{I} + \frac{P}{A}. \text{ (52, 62.)}$$

S = Strain per square inch in extreme fiber.

M = Moment of transverse force in inch pounds.

n = Distance center of gravity to top or bottom of final section
in inches.

I = Final moment of inertia.

P = Direct load.

A = Final area.

		Soft Steel.	Soft Medium Steel.	
17.	Pins and rivets.....	10,000		(57.)
	Web plates.....		7,000	Shearing.
18.	On dia. of pins and rivet holes	20,000	20,000	(57.) Bearing.
19.	Extreme fiber of pins.....		25,000	Bending.
	Extreme fiber of purlins.....		15,000	(49.)
20.	Lateral connections will have 25 per cent greater unit			Laterals.
strains than above.				

21. Bolts may be used for field connections at two-thirds of **Bolts.**
rivet values. (17, 18.)

TIMBER PURLINS.

22. In purlins of yellow pine, southern pine, or white oak, the **Timber.**
extreme fiber strain shall not exceed 1200 lbs. per sq. in. (50.)

PLATE GIRDERS.

23. The length of span shall be considered as the distance from **Girders.**
center to center of end bearings when girders rest on bottom
flange, and from end to end when fastened between columns by
connection angles.

Flanges.

24. The compression flanges shall be stayed transversely when their length is more than thirty times their width. (15.)

One-sixth of the web shall be included as flange area, provided proper horizontal splices are made at web joints.

Stiffeners.

25. All web plates shall be stiffened at the inner and outer edges of the end bearings and at all points of local concentrated loading.

Intermediate stiffeners shall be used provided the shearing strain per square inch exceeds that given by the formula:

$$\frac{15,000}{1 + \frac{d^2}{3000 t^2}} \cdot d = \text{Clear dist. between flange angles in inches.}$$

$$t = \text{Thickness of web in inches.}$$

CORRUGATED IRON COVERING.**Covering.**

26. Corrugated iron shall generally be of 2½-inch corrugations, and the gauge in U. S. standard shall be shown on strain sheet.

27. The span or distance center to center of roof purlins shall not exceed that given in the following table:

	ft.	in.		ft.	in.
27 gauge.....	2	0	20 gauge.....	4	6
26 gauge.....	2	6	18 gauge.....	5	0
24 gauge.....	3	0	16 gauge.....	5	6
22 gauge.....	4	0			

(48.)

28. All corrugated iron shall be laid with one corrugation side lap, and not less than four inches end lap, generally with six inches end lap. (32.)

Valleys.

29. All valleys or junctions shall have flashing extending at least 12 inches under the corrugated iron, or 12 inches above line where water will stand. (35, 36.)

Ridges.

30. All ridges shall have roll cap securely fastened over the corrugated iron.

Fastenings.

31. Corrugated iron shall preferably be secured to the purlin by galvanized straps of not less than five-eighths of an inch wide by No. 18 gauge; these shall pass completely around the purlin, and have each end riveted to the sheet. There shall be at least two fastenings on each purlin for each sheet.

32. The side laps shall be riveted with six pound rivets not more than six inches apart. (28.)

Finish Angle.

33. At the gable ends the corrugated iron shall be securely fastened down on the roof, to a finish angle or channel, connected to the end of the roof purlins.

VENTILATORS AND LOUVERS.**Ventilators.**

34. Ventilators shall be provided and located so as to properly ventilate the building. They shall have a net area of openings for each 100 square feet of floor surface of not less than one-half a square foot for machine shops, of not less than five square feet for mill buildings, and not less than seven square feet for forge shops.

Louvers shall be provided in ventilators, if necessary, of such **Louvers.** form as to prevent the blowing in of snow or storm water, and of a stiff enough section not to sag below horizontal and appear unsightly. They shall not be less than No. 16 gauge galvanized for flat louvers, and No. 20 gauge galvanized for corrugated louvers.

LIGHTING.

35. Windows shall be provided in the sides and clearstory or **Windows.** ventilator of a surface equal to not less than 10 per cent of the entire exterior surface of the buildings, in mill buildings, and of not less than 20 per cent in machine shops or similiar buildings. (29.)

36. At least half of the lighting specified shall preferably be in **Skylights.** the form of skylights of some form of construction which shall entirely prohibit leaking. (29.)

DETAILS OF CONSTRUCTION.

37. All tension members shall preferably be composed of **Tension** angles or shapes with the object of stiffness. **Members.**

38. All joints shall have full splices and not rely on gussets. (65.)

39. All main members shall preferably be made of two angles, back to back, two angles and one plate, or four angles laced. (67.)

40. Secondary members shall preferably be made of symmetrical sections.

41. Long laterals or sway rods may be made of bar, with sleeve nut adjustment, to facilitate erection.

42. Members having such a length as to cause them to sag shall be held up by sag ties of angles, properly spaced.

43. Rafters shall preferably be made of two angles, two angles **Compression** and one plate, or of such form as to allow of easy connection for **Members.** web members. (65.)

44. All other compression members, except sub-struts, shall be composed of sections symmetrically disposed. (65.)

45. Sub-struts shall preferably be made of symmetrical sections.

46. The trusses shall be spaced, if possible, at such distances **Purlins.** apart as to allow of single pieces of shape iron being used for purlins, trussed purlins being avoided, if possible. Purlins shall preferably be composed of single angles, with the long leg vertical and the back toward the peak of the roof.

47. Purlins shall be attached to the rafters or columns by clips, with at least two rivets in rafter and two holes for each end of each purlin.

48. Roof purlins shall be spaced at distances apart not to exceed the span given under the head of Corrugated Iron. (27.)

49. Purlins extending in one piece over two or more panels, laid to break joint, and riveted at the ends, may be figured as continuous.

50. Timber purlins, if used, shall be attached in the same manner as steel purlins.

- Sway Bracing.** 51. Sway bracing shall be introduced at such points as are necessary to insure ease of erection and sufficient transverse and longitudinal strength. (41.)
52. All such strains shall preferably be carried to the foundation direct, but may be accounted for by bending in the columns. (62.)
- Bed Plates.** 53. Bed plates shall never be less than one-half inch in thickness, and shall be of sufficient thickness and size so that the pressure on masonry will not exceed 300 pounds per square inch. Trusses over 75 feet span on walls or masonry shall have expansion rollers if necessary. (54.)
- Anchor Bolts.** 54. Each bearing plate shall be provided with two anchor bolts of not less than three-fourths of an inch in diameter, either built into the masonry or extending far enough into the masonry to make them effective. (53.)
- Punching.** 55. The diameter of the punch shall not exceed the diameter of the rivet, nor the diameter of the die exceed the diameter of the punch by more than one-sixteenth of an inch. (56.)
- Punching and Reaming.** 56. All rivet holes in steel may be punched, and in case holes do not match in assembled members they shall be reamed out with power reamers. (71.)
- Effective Diameter of Rivets.** 57. The effective diameter of the driven rivet shall be assumed the same as before driving, and in making deductions for rivet holes in tension members, the hole will be assumed one-eighth of an inch larger than the undriven rivet. (13, 17.)
- Pitch of Rivets.** 58. The pitch of rivets shall not exceed twenty times the thickness of the plate in the line of strain, nor forty times the thickness at right angles to the line of strain. It shall never be less than three diameters of the rivet. At the ends of compression members it shall not exceed four diameters of the rivet for a length equal to the width of the members.
- Length of Compression Members.** 59. No compression member shall have a length exceeding fifty times its least width, unless its unit strain is reduced accordingly. (14.)
- Tie Plates.** 60. Laced compression members shall be stayed at the ends by batten plates having a length not less than the depth of the member.
- Lacing Bars.** 61. The sizes of lacing bars shall not be less than that given in the following table, when the distance between the gauge lines is — (62.)
- | | |
|---------------------------------------|--|
| 6 inches or less than 8 inches..... | $1\frac{1}{4}$ inches \times $\frac{1}{4}$ inch |
| 8 inches or less than 10 inches..... | $1\frac{1}{2}$ inches \times $\frac{1}{4}$ inch |
| 10 inches or less than 12 inches..... | $1\frac{3}{4}$ inches \times $\frac{5}{16}$ inch |
| 12 inches or less than 16 inches..... | 2 inches \times $\frac{3}{8}$ inch |
| 16 inches or less than 20 inches..... | $2\frac{1}{4}$ inches \times $\frac{7}{16}$ inch |
| 20 inches or less than 24 inches..... | $2\frac{1}{2}$ inches \times $\frac{1}{2}$ inch |
| 24 inches or above of angles. | |

They shall generally be inclined at 45 degrees to the axis of the member, but shall not be spaced so as to reduce the strength of the member as a whole.

62. Where laced members are subjected to bending, the size of lacing bars or angles shall be calculated or a solid web plate used.

(13, 14, 61.)

Bending.

63. All rods having screw ends shall be upset to standard size, or have due allowance made.

Upset Rods.

64. No metal of less thickness than one-fourth inch shall be used, except as fillers, and no angles of less than two-inch leg. A variation of 3 per cent shall be allowable in the weight or cross section of material.

Variation in Weight.

WORKMANSHIP.

65. All workmanship shall be first class in every particular. All abutting surfaces of compression members, except where the joints are fully spliced, must be planed to even bearing so as to give close contact throughout. (38.)

Finished Surfaces.

66. All planed or turned surfaces left exposed must be protected by white lead and tallow. (89.)

67. Rivet holes for splices must be so accurately spaced that the holes will come exactly opposite when the members are brought into position for driving rivets, or else reamed out. (38, 70, 71.)

Rivets.

68. Rivets must completely fill the holes and have full heads concentric with the rivet holes. They shall have full contact with the surface, or be countersunk when so required, and shall be machine driven when possible. Rivets must not be used in direct tension.

69. Built members when finished must be free from twists, open joints or other defects. (65.)

70. Drift pins must only be used for bringing the pieces together, and they must not be driven so hard as to distort the metal. (71.)

Drilling.

71. When holes need enlarging, it must be done by reaming and not by drifting. (70.)

Reaming.

72. The decision of the engineer or architect shall control as to the interpretation of the drawings and specifications during the progress of the work. But this shall not deprive the contractor of right of redress after work is completed, if the decision shall be proven wrong. (1, 91, 95.)

Drawings and Specifications.

QUALITY OF MATERIAL.

Wrought Iron.

73. All wrought iron must be tough, ductile, fibrous and of uniform quality. Finished bars must be thoroughly welded during the rolling, and be straight, smooth and free from injurious seams, blisters, buckles, cracks or imperfect edges.

Character and Finish.

74. No one process of manufacture is preferred over another, provided the material complies with this specification.

Manufacture.

75. For tension tests the test piece shall have as near one-half square inch of sectional area as possible, and a length of at least 8 inches with uniform section, for determining the elongation.

Standard Test Pieces.

- Elastic Limit.** 76. The elastic limit shall not be less than 26,000 pounds per square inch for all classes of iron.
- Tension Iron.** 77. Standard test pieces from iron having a section of $4\frac{1}{2}$ square inches or less shall show an ultimate strength of not less than 50,000 pounds per square inch and an elongation in 8 inches of not less than 18 per cent.
78. Standard test pieces from bars of more than $4\frac{1}{2}$ square inches section will be allowed a reduction of 500 pounds for each additional square inch of section, provided the ultimate strength does not fall below 48,000 pounds or the elongation in 8 inches below 15 per cent.
79. All iron for tension members must bend cold through 90 degrees to a curve whose diameter is not over twice the thickness of the piece, without cracking.
80. Not less than one sample out of three shall bend cold to this curve through 180 degrees, without cracking.
81. When nicked on one side and bent by a blow from a sledge, the fracture must be wholly fibrous.

Steel.

- Manufacture.** 82. Steel made either by the Bessemer or Open Hearth process of manufacture shall be acceptable.
- Standard Test Pieces.** 83. Test pieces for tension and bending tests shall have as near one-half square inch of sectional area as possible and a length of at least 8 inches with uniform section, for determining elongation.
84. One test piece for tension and one for bending are to be taken from each heat or blow of finished material.
- Finish.** 85. Finished bars must be free from flaws, cracks or injurious seams and have a first-class finish.
- Grades of Steel.** 86. Steel of soft and soft medium grades only are to be used, the soft steel for rivets and offset or bent angles or plates, and soft medium for all other parts where iron is not optional. The phosphorus shall never exceed in any steel 0.08 per cent, nor the sulphur 0.04 per cent. (56.)
- Phosphorus and Sulphur Limit.**
- Soft Steel.** 87. Standard test pieces of finished material shall have an ultimate strength of from 50,000 to 60,000 pounds per square inch; an elastic limit of one-half the ultimate strength; an elongation in 8 inches of not less than 25 per cent; and a reduction of area at fracture of not less than 50 per cent. Samples to bend cold 180 degrees flat on itself, without sign of fracture on the outside bent portion.
- Soft Medium Steel.** 88. Standard test pieces of finished material shall have an ultimate strength of from 55,000 to 65,000 pounds per square inch; elastic limit not less than one-half the ultimate strength; an elongation in 8 inches of not less than 25 per cent; and a reduction of area at fracture of not less than 50 per cent. Samples to bend cold 180 degrees to a diameter equal to the thickness of the sample without crack or flaw on the outside of the bent portion.

PAINTING.

89. All iron or steel framing and all corrugated iron, unless **Painting.** galvanized, shall have one coat of pure lead paint before leaving the shop; all surfaces in contact shall have one heavy coat of pure lead paint before assembling, and all planed or turned surfaces shall be coated with white lead and tallow. (66.)

90. Parts difficult of access after erection shall have two coats of pure lead paint at the shop.

91. After erection all the work except galvanized iron shall receive one coat of pure lead paint of such shade as the engineer or architect may select, and it shall be thoroughly and evenly applied. (72, 95.)

ERECTION.

92. The contractor will furnish all tools, derricks or staging **Erection.** and material of every description for the erection of the whole or such portions of the work as are included in the contract, and remove the same when the work is completed, leaving the premises as free from rubbish or obstruction as when the erection was commenced.

93. The contractor shall assume all risks from storms or accidents to the work, unless caused by the negligence or interference of the owner or his employees; also all damage to persons and properties and casualties of every description, until the final acceptance of the completed structure.

94. The contractor shall comply with all ordinances or regulations of the authorities having jurisdiction over the premises or abutting premises.

95. The erection is to be carried on subject to the approval and inspection of the engineer or architect, and it is to be completed to his satisfaction and in full accordance with the contract (72, 91.)

Specifications for Structural Steel and Wrought-iron Mill Products.

(Prepared by Bureau of Yards and Docks.)

ISSUED BY THE NAVY DEPARTMENT, OCTOBER 4, 1907.

1. *Mill orders.* — The contractor shall furnish the Bureau of Yards and Docks with complete copies of mill orders, in triplicate, and no material shall be rolled before the copies shall have been received by the Bureau.

2. *Steel manufacture and properties.* — Steel shall be made by the open-hearth process and have chemical and physical properties in conformity with the following limits:

Elements Considered.	Plates, Shapes, and Bars.	Rivet Steel.	Steel Castings.	Iron.
Phosphorus, maximum (basic).	0.04 per cent	0.04 per cent	0.05 per cent	.....
Phosphorus, maximum (acid).	0.06 per cent	0.04 per cent	0.08 per cent	.....
Sulphur, maximum.....	0.05 per cent	0.04 per cent	0.05 per cent	.....
Ultimate tensile strength (pounds per square inch).	56,000 to 64,000.	46,000 to 54,000.	65,000 minimum.	50,000 minimum.
Elongation, minimum per cent in 8 inches. }	1,500,000	1,500,000	.....	18.
cent in 2 inches. }	Ult. T. Str.	Ult. T. Str.	.....	.....
Elongation, minimum per cent in 2 inches.	22.....	.....	15.....	.....
Character of fracture.....	Silky.....	Silky.....	Silky or fine granular.	Wholly fibrous.
Cold bends without fracture	180° flat....	180° flat....	90° d = 3 t..	135° d = 2 t.

Rivet steel, when nicked and bent around a bar of the same diameter as the rivet rod, shall give a gradual break, and a fine, silky, uniform fracture. Iron, when nicked and bent, shall show a fracture at least 90 per cent of which is fibrous.

3. *Allowable variation in physical properties.* — If first test shows ultimate strength for plates, shapes, bars, or rivet steel to be outside of prescribed limits, a retest shall be made on the same gauge, which, to be acceptable, shall be within 1000 pounds of the specified limits. Elongation limits for material less than $\frac{1}{4}$ inch thick, or in excess of $\frac{3}{4}$ inch in thickness, may be reduced 1.25 per cent for each $\frac{1}{8}$ inch of variation. Cold bending tests for plates, shapes, and bars which are 1 inch or more in thickness, will be satisfactory if specimen bends 180° around a pin having diameter twice the thickness of the specimen, without showing fracture on outside of bend. Steel bars for reinforced concrete will be satisfactory if maximum ultimate strength does not exceed 90,000 pounds per square inch, and when bars will bend cold 180° without fracture around their thickness multiplied by $\frac{\text{ultimate strength} - 55,000}{7500}$.

4. *Allowable variation in weight.* — A variation in cross section or weight of each piece of steel of more than 2.5 per cent from that specified will be

sufficient cause for rejection, except in the case of sheared plates, for which variations will be permitted as allowed in the standard specifications adopted in 1906 by the American Railway Engineering and Maintenance of Way Association.

5. *Finish.* — Finished material shall be free from injurious seams, flaws, cracks, defective edges, or other defects, and have a smooth, uniform, and workmanlike finish. Plates 36 inches in width and under shall have rolled edges.

6. *Steel castings.* — All steel castings shall be true to pattern and shall be annealed to the satisfaction of the inspecting engineer. Castings shall be free from cold shuts, sand holes, blow holes, and any other defect which in the opinion of the inspecting engineer would cause or tend to make them unsuitable for the service for which they might be intended.

7. *Wrought iron.* — Wrought iron shall be double-rolled, tough, fibrous, uniform in character, thoroughly welded in rolling, and free from surface defects.

8. *Stamping.* — Every finished piece of steel shall have the melt number and the name of the manufacturer stamped or rolled upon it. Steel and pins for rollers shall be stamped on the end. Rivet and lattice steel and other small parts may be bundled, with the above marks on an attached metal tag.

9. *Rules governing physical tests.* — Test bars shall have forms and dimensions as required by the general specifications adopted in 1906 by the American Railway Engineering and Maintenance of Way Association. Specimens for physical tests representing material in plates, shapes, and bars shall be made upon coupons cut from the finished product and shall have both faces rolled and both edges either milled to form, parallel, or turned to a diameter of $\frac{3}{4}$ inch; parallel edges shall have a length of at least 9 inches; specimens shall be provided with enlarged ends. Tensile, elongation, and fracture tests representing material in pins, rollers, and steel castings shall be made upon turned specimens having a uniform reduced diameter of $\frac{1}{2}$ inch for a length of 2 inches between enlarged ends; bending tests shall be made upon specimens 1 inch by $\frac{1}{2}$ inch. Specimens representing pins and rollers shall be cut from the finished stock in such manner that the center of the specimen shall be 1 inch from the surface of the bar. Specimens representing steel castings shall be made from coupons which are molded, cast, and annealed as integral parts of the castings and which are not cut from the castings until after the completion of the annealing process; individual coupon tests and reports will be made for each casting unless otherwise elsewhere specified. Bending tests may be made either by pressure or by blows.

10. *Tests and test reports.* — Chemical determinations of the percentages of carbon, phosphorus, sulphur, and manganese shall be made by the manufacturer from a test ingot taken at the time of pouring of each melt of steel, and a correct copy of such analysis in triplicate shall be furnished the inspecting engineer. The manufacturer shall also make at least one set of physical tests from each melt of steel and iron as rolled or cast; in case steel differing $\frac{3}{8}$ inch and more in thickness is rolled from one melt, a test shall be made from the thickest and thinnest material rolled. Each set of tests will include the determination of ultimate tensile strength, elongation, character

of fracture, cold bending, and yield point as indicated by drop of beam. In case the United States may desire check analyses at any time, such analyses shall be made at the expense of the United States, and an excess of 25 per cent will be allowed for such results, as compared with the limits prescribed in the table.

11. *Mill tests and inspections.* — Mill analyses, tests, inspections, and reports shall be made entirely by the manufacturer, or by the manufacturer subject to the supervision and direction of a Government inspector, as may be elected by the Bureau of Yards and Docks. The manufacturer, at his own expense, shall furnish all facilities for inspecting and testing the weight and quality of all material at place of manufacture, and shall furnish suitable laboratory and testing machines and prepare samples and specimens for testing. The inspector shall be given ample notice as to the mill's schedule in order that he may take samples or make analyses, tests, or inspections, but it is understood that the routine operations of the mill will not be delayed, due to the absence of the inspector, but in such case the manufacturer will proceed with the tests and inspections as though no inspector had been detailed. The inspector shall have free access, at all times, to all parts of the mill where material to be inspected by him is being manufactured or tested. Analyses, tests, and inspections shall be made in accordance with recognized standard methods. The manufacturer shall prepare and furnish the inspector, in triplicate (or the Bureau of Yards and Docks in case no inspector has been detailed), with complete copies of reports, also complete shipping invoices for each shipment. The manufacturer shall guarantee and be held responsible for the accuracy of all analyses, tests, inspections, and reports.

12. *Defective material.* — Material which, subsequent to the prescribed tests at the mills and its acceptance there, develops weak spots, brittleness, cracks, or other imperfections, or is found to have injurious defects, will be rejected at the shop and shall be replaced by the manufacturer at his own expense.

13. *Shipping invoices.* — Complete copies of shipping invoices for each shipment, in triplicate, shall be furnished the inspecting engineer, or be forwarded to the Bureau of Yards and Docks in case there has been no inspector detailed.

SHOP WORK.

14. *Shop orders.* — The contractor shall furnish the Bureau of Yards and Docks with complete copies of shop orders, in triplicate, and shall also notify the Bureau at least 10 days before shop work is to be commenced in order that proper arrangements may be made for shop inspection.

15. *General requirements.* — All members forming a structure shall be built in accordance with approved drawings. Workmanship and finish shall be equal to the best practice in modern bridge work. No material less than $\frac{5}{16}$ inch in thickness shall be used, except for fillers, beams, and channels, unless specifically required by the contract. Lattice bars shall have neatly rounded ends unless otherwise specified. Stiffeners shall fit neatly between flanges of girders, and where tight fits are called for, the ends of stiffeners shall be faced and be

brought to a true contact bearing with flange angles. Web splice plates, and fillers under stiffeners, shall be cut to fit within $\frac{1}{8}$ inch of flange angles. The clearance between ends of spliced web plates shall not exceed $\frac{1}{4}$ inch. The several pieces forming one built member shall be straight and fit closely together. Finished members shall be free from twists, bends, or open joints. Compression joints, depending upon contact bearing, shall have surfaces truly faced so as to have full contact bearing when perfectly aligned and riveted up complete. All faces and surfaces shall be truly planed where so required by the contract. Pin holes shall be bored after members are riveted; shall be true to gauges, smooth, straight, at right angles to the axis of the member, and parallel to each other, unless otherwise specified; shall be accurately spaced to within $\frac{1}{32}$ inch. Pins and rollers shall be accurately turned to gauges and shall be straight and smooth and entirely free from flaws. Diameter of pin holes shall not exceed diameter of pins by more than $\frac{1}{32}$ inch. Screw threads shall make tight fits in the nuts and shall be United States standard, except above the diameter of $1\frac{3}{8}$ inch, when they shall be made with 6 threads per inch. Steel, except in minor details, which has been partially heated, shall be annealed. Welds in steel will not be allowed. Ends of tension rods shall be upset so that failure in service would occur in the body of the rods. Expansion bedplates shall be planed true and smooth; cast wall-plates shall be planed top and bottom; cut of planing tool shall correspond with the direction of the expansion. Pins, nuts, bolts, rivets, and other small details shall be boxed or crated; weights shall be plainly marked on the packages. Field rivets shall be furnished to the amount of 15 per cent plus 10 rivets in excess of the nominal number required for each size.

16. *Preparation of material before assembling.* — Material shall be thoroughly straightened in the shop by methods which will not injure it, and be cleaned of rust and dirt if such exists before being laid off or worked in any way. Shearing shall be neatly done and all portions of the work which will be exposed to view after completion shall be neatly finished. Surfaces in contact after assembling shall be painted before being assembled.

17. *Rivets, rivet holes, riveting, and bolts.* — Size of rivets as designated on plans shall be understood to mean the actual size of the cold rivet before heating. Pitch of rivets shall not be less than 3 times the diameter of the rivet, nor greater than 6 inches or 16 times the thickness of the thinnest outside section. Punching shall be accurately done; when general reaming is not required, the diameter of the punch shall not be more than $\frac{1}{16}$ inch greater than the diameter of the rivet, nor the diameter of the die more than $\frac{1}{8}$ inch greater than the diameter of the punch; material more than $\frac{3}{4}$ inch thick shall be subpunched and reamed or drilled from the solid; drifting to enlarge unfair holes will not be permitted; if holes must be enlarged to admit the rivet, they shall be reamed; poor matching of holes will be cause for rejection. Riveted members shall have all parts well pinned up, and firmly drawn together with bolts before riveting is commenced. Rivets shall be driven by pressure tools wherever possible and pneumatic hammers shall be used in preference to hand driving. Completed rivets shall look neat and finished; shall have heads of approved shape, full and of equal size; heads shall be central on shank and grip the assembled pieces firmly. Recupping and caulking of rivets will not be permitted. Loose,

burned, or otherwise defective rivets shall be cut out and replaced; great care shall be taken in cutting out rivets not to injure the adjacent metal, and, if necessary, they shall be drilled out. Whenever bolts must be used in place of rivets to transmit shear, the holes shall be reamed parallel and the bolts turned to a driving fit; washers not less than $\frac{1}{4}$ inch thick shall be used under nuts.

18. *Reamed work.* — When reaming is required by the contract, the punch used shall have a diameter not less than $\frac{3}{16}$ inch smaller than the nominal diameter of the rivet. Reaming shall be done after the pieces forming one built member are assembled and firmly bolted together, using twist drills having diameter $\frac{1}{16}$ inch larger than the nominal diameter of the rivet. Outside burrs on reamed holes shall be removed.

19. *Shop paint and painting.* — All steel work, except rods for reenforcing concrete, shall be painted or coated at the shop before shipment. Exposed surfaces which are inaccessible after fabrication shall be given two coats of paint; all other surfaces, except machine-finished surfaces but including surfaces in contact after assembling, shall be given one coat of paint. All surfaces shall be carefully cleaned of all moisture, scale, rust, grease, dirt, chips, and other foreign matter before being painted, and, in case two coats of paint are required, the first coat shall be dry before the second coat is applied. No painting shall be done in wet or freezing weather except under cover. Machine-finished surfaces shall be coated with white lead and tallow before being put out into the open air. Paint for shop coats shall be composed of red lead, white zinc, raw linseed oil, and turpentine Japan dryer mixed in proportions of 100 pounds of lead, 20 pounds of zinc, 5 gallons of oil, and $3\frac{1}{2}$ pints of dryer. Paint shall be freshly mixed in small quantities and be well stirred before using. Paint materials shall conform to Navy Standard Specifications, so far as same are applicable.

20. *Shop inspection.* — The manufacturer shall furnish all facilities for inspecting and testing the weight and quality of workmanship at the shop where material is manufactured. Shop inspection will be made by an inspecting engineer assigned by the Bureau of Yards and Docks, unless such inspection shall not be considered warranted by the Bureau because of the magnitude or the character of the work, in which case shop inspection will be made by the manufacturer. The inspecting engineer shall have full access at all times to all parts of the shop where material under his inspection is being manufactured. The inspecting engineer shall stamp each piece which is accepted with a private mark; any piece not so marked may be rejected at any time and at any stage of the work. It shall be distinctly understood that shop inspection shall not operate in any manner to relieve the manufacturer from full responsibility for the accuracy and character of the work in all of its details, and that errors or faults which may be discovered after delivery or during erection shall be satisfactorily corrected by the manufacturer in accordance with the requirements of the contract and without any increase in the contract price.

21. *Loading and shipping invoices.* — Material shall be so prepared for shipment and be so loaded that it will suffer no distortion or damage during transportation. Complete copies of shipping invoices for each shipment, in triplicate, shall be furnished the inspecting engineer, or be forwarded to the Bureau of Yards and Docks in case there has been no inspector detailed.

FIELD WORK.

22. *Unloading, storing, and handling.* — Material shall be unloaded, stored, and handled in such manner and with such appliances and care as to prevent the distorting and injuring of the members; material which is injured shall be repaired or replaced if necessary, as may be required by the officer in charge and at the expense of the contractor.

23. *Erecting.* — All field connections shall be riveted. The various members forming parts of a completed frame or structure after being assembled shall be accurately aligned and adjusted before riveting is begun. All requirements specified for shop work which are applicable shall apply to field work.

24. *Painting steelwork after erection.* — Steel for reenforcing concrete shall not be painted. Surfaces which are to remain in free contact with air but which are to be covered in or incased by brickwork, fireproofing or framing, shall be given one coat of paint. All surfaces which are to remain exposed upon the completion of the structure, both exterior and interior, shall be given two coats of paint. Surfaces which have been chafed or imperfectly covered shall be properly retouched and allowed to dry before applying any final coat of paint. Freshly painted surfaces shall be allowed to dry before being inclosed. Both coats of paint used for finishing exposed surfaces shall be composed of white lead and boiled linseed oil, which conform with requirements of Navy Standard Specifications, mixed in proportions and colored as may be directed by the officer in charge. Paint used for inclosed surfaces shall be the same as required for shop coat. Painting shall be done only at such times as may be approved by the officer in charge and subject to the same restrictions as to weather and preparation of surfaces as specified for shop coats. Succeeding coats of paint shall be mixed so as to vary somewhat in color in order that there may be no confusion as to the surfaces which have been painted.

25. *Steel for reenforcing concrete.* — Steel shall be stored under shelter; shall be cleaned from all loose scale, oil, grease and dirt before being embedded; and shall be secured in place to the satisfaction of the officer in charge.

Copies of the above specifications can be obtained upon application to the various navy pay offices or to the Bureau of Supplies and Accounts, Navy Department, Washington, D. C.

References: Bureau of Supplies and Accounts, case 102908; Bureau of Yards and Docks, 5,862, October 3, 1907.

CHAPTER IV.

SPECIAL FORMS OF SPECIFICATIONS.

THE specifications discussed in the last chapter were those of a general character, and so worded that they can be applied to any particular work by adding a few pages describing the piece of work for which they are to be used.

The special forms to be discussed in this chapter are those of the War and Navy Departments of the United States Government. In some respects they are general as well, especially as regards the General Instructions for Bidders and General Conditions, but in the latter parts they are applied to special pieces of work.

Many of the clauses in both the War and Navy specifications are prescribed by law, while others are forms which have become established by long usage.

The specification for dredging Olympia Harbor is one that we will discuss in detail; it is issued by the Engineer's Department of the War Department.

The first section is the advertisement of the work, which is also published in newspapers of both national and local circulation, so as to reach all the persons or firms likely to bid on such work. In this is named the day, hour, and place at which bids will be received. The information is also given that "Specifications, blank forms, and all available information will be furnished on application" at the U. S. Engineer's office, in the Burke Building, Seattle, Washington.

Then follow the "specifications" proper, which are divided into "General Instructions for Bidders," "General Conditions," and lastly "Special Conditions."

After these are blank forms for "Proposal for Dredging," "Guarantee to Accompany Proposal," for a corporation or bond company, and "Guarantee to Accompany Proposal," for individuals.

We will now proceed to discuss these in detail by taking them up item by item as far as the limitations of this work will permit.

Item No. 1. Under general instructions for bidders, refers to the United States statutes, which prohibit the importation of aliens or foreigners, under contract, to perform labor in the United States. This law was made supposedly to protect the citizens of the United States, but in some respects I regard it as a very bad thing, as it is part and parcel of all such laws as the tariff law, which in theory are entirely wrong. I do not believe that in the great majority of cases any great harm is done to citizens of the United States by foreigners being allowed to come into the country, because conditions are very often such that it is almost impossible to carry on a piece of work of any magnitude without the aid of foreigners or foreign laborers.

Item No. 2. Is another clause somewhat similar to No. 1, giving preference to the use of articles of domestic production.

Item No. 3. Specifies that no proposals will be considered unless accompanied by a guaranty. This guaranty will be found at the end of the specification. The one usually filled out is from a surety company, agreeing that it will go on the bond of the contractor in case the contract is awarded to him. It used to be customary to go to some friends and ask them to go on the bond, but now there are surety and bond companies that stand ready to go on a bond for almost any amount. This relieves the contractor of the necessity of asking friends to go personal security for him — a thing which a great many do not like to do. Only the other day a gentleman asked me to sign a bond for a small amount; I did so, but it was very much against my inclination. The thing to do is to go to a surety company when you want a bond for any work, and let others do the same. The guaranties on the succeeding pages are for individual securities. The blank spaces explain themselves. All bonds for the War Department are made in triplicate (Item 4); the first being for the engineer in charge of the work, the second for the division engineer, and the third goes to the War Department at Washington.

The guaranty is specified under Item 5, to be signed by the surety company, or by two responsible guarantors.

Item No. 6. Specifies that an individual a member of the firm or corporation or partnership will not be accepted as a surety, this being the same in effect as a person going on his own bond.

Item No. 7. Specifies how the signature to a bond should be made and witnessed, together with the seal, etc. In the case of a corporation going on a bond, it has to file with the bond a blank form, properly filled out, showing that the official signing for the corporation is properly authorized to do so, and that the bonds have been accepted by the War Department at Washington.

Item No. 8. Specifies the exact amount for which each guarantor must justify for this particular piece of work. There are some blanks at the end for bondsmen to fill out. Each bondsman is required to go before a notary public or some other like official and swear that he is worth double the amount of money for which he goes on a bond, over and above all his just debts and liabilities.

Item No. 10. Refers to something which is more fully set forth in Bolles's book on Commercial Law. In effect it is that where a contract of any kind is made by or with a corporation, one or more of the officers of the corporation, who are duly authorized to do so, must sign the contract or agreement in behalf of the corporation. The name of the corporation must be signed, and the name of the official who is authorized to act for the corporation, together with his title, and the seal of the corporation attached. The Government always requires that a company making a contract shall file with the department a copy of the minutes or records of the company, showing where and how this official was authorized to act and sign for the company.

Item No. 11. Requires all prices to be written out in full, as well as expressed in figures, so as to make sure that they may be rightly understood and that no mistake may occur.

Item No. 12. Requires that a copy of the advertisement calling for bids, instructions to bidders, and specifications must be securely attached to the proposal. In all cases where the War Department is concerned these are all attached and bound together.

Item No. 13. Makes it obligatory on the part of the bidder to make out his bid or proposal without the aid or assistance of any person in the employ of the Government. This is as a guard against any collusion or favoritism.

Item No. 14. Specifies that no bidder will be informed directly or indirectly of the name of any person who is making a bid or

who is going to make a bid for the same piece of work. This is considered necessary in order to prevent collusion between two or more parties or firms bidding for the same work.

Item No. 15. Requires that all the blank spaces in the proposal and bond must be filled in, and that no change must be made in the wording. In some instances there may be added to a bid supplemental figures on some other basis, but only occasionally is a bid accepted in which the work is to be done on a changed specification.

Item No. 16. Provides that in case there are any alterations or erasures the same must be fully explained.

Item No. 17. Provides that a bidder can withdraw his bid before the time set for opening same, if he so desires.

Item No. 18. Provides that no bid can be received after the time set. The War Department, and in fact all the Government Departments, are very particular about having the bids filed exactly according to regulations. That is, the bids must be enclosed in the manner specified and the envelopes must be addressed in just such a way, and must state what the bid is for, and the name of the bidder, etc. There must not be too much, either; but if a single word that ought to be there is left out it might be construed as making the bid informal, and the bid might be thrown out for that reason alone.

Item No. 20. Specifies that the quantities and the measurements given are only approximate, and that no claim shall be made against the United States for any difference after the work is started. The same thing is true about the locality. The bidder is expected to examine the locality for himself, and the lay of the ground, so that he may know what he is bidding on, and he must also make sure what kind of material is to be excavated.

Item No. 21. Specifies that the United States has the right to reject any and all bids, and also reserves the right to waive any informality if it so desires; it then goes on to specify the causes that may invalidate the proposal.

Item No. 22. Specifies that the bidder shall enter into the contract and give a bond for the sum of five thousand dollars, and that this bond must be furnished within ten days. This bond is for the faithful performance of the work according to contract. In case the work is not so performed, the bond is forfeited, or the bondsmen may arrange to complete the work.

Item No. 23. Is a clause directing how the affidavit of sureties should be made.

Item No. 24. Invites bidders to be present at the opening of the bids.

Item No. 25. The first paragraph under General Conditions specifies that all the bidding papers must not only be attached to the proposal but that they become a part of the contract itself.

Item No. 26. Requires the contractor to furnish the Department with his regular address.

Item No. 27. Prohibits the contractor from subletting his work. The reason for this is that the Government wants to deal directly and only with the party who is doing the work. While the contractor very often does sublet work, the Government does not in any legal way recognize the subcontractor.

Item No. 29. Makes the engineer officer in charge the sole arbiter as to the quality and quantity of the materials and work.

Item No. 30. Provides for the terms of payment on the work as it progresses. This is usually done under monthly estimates made by the engineer in charge. A certain percentage of the work done is paid for each month, the balance being held until the completion of the work and the acceptance of the same, when the final and full payment is made.

Item No. 31. Requires the contractor to prosecute the work with faithfulness and energy, and names the time for the completion of the work as eight calendar months. That is a very fair length of time in this instance, but a great many Government contracts make the time entirely too short.

Item No. 32. Specifies the conditions under which extensions of time are granted.

Item No. 33. Requires the contractor to stand between the Government and any claimant to any patented article that may be used.

Item No. 34. Is the first of "Special Conditions." The items from No. 34 to No. 55, inclusive, are quite explicit, and tell what the work is that is to be done and how it is to be done. These paragraphs come up closely to the definition we had in the last chapter.

Item No. 35. Gives the exact dimensions of the channel to be excavated.

Item No. 36. States that the material to be excavated is believed to be mud and sand, but that no guaranty will be given as to its exact character. The Government offers to give all the information it has, but it is usually impossible to tell without examination just what is the character of the material to be excavated.

There is nothing which requires any special mention in the other paragraphs, except that I should like to call attention to one of the clauses, Item 51, which requires that no work shall be done on Sundays or national holidays, except in case of emergency, and that no work shall be done between sunset and sunrise; but I never knew a case where this latter clause was not waived by the engineer officer.

Specification for Dredging Olympia Harbor, Washington.

Advertisement.

U. S. ENGINEER OFFICE,

ROOM 602 BURKE BUILDING, SEATTLE, WASH.

November 15, 1902.

Sealed proposals for DREDGING OLYMPIA HARBOR, WASH., will be received at this office until 12 o'clock noon, December 18, 1902, and then publicly opened. Specifications, blank forms, and all available information will be furnished on application to this office.

JOHN MILLIS, Maj. Engrs.

SPECIFICATIONS.

GENERAL INSTRUCTIONS FOR BIDDERS.

1. The attention of bidders is especially invited to the acts of Congress approved February 26, 1885, and February 23, 1887, as printed in vol. 23, page 332, and vol. 24, page 414, United States Statutes at Large, which prohibit the importation of foreigners and aliens, under contract or agreement, to perform labor in the United States or Territories or the District of Columbia.

2. Preference will be given to articles or materials of domestic production, conditions of quality and price being equal, including in the price of foreign articles the duty thereon.

3. No proposal will be considered unless accompanied by a guaranty which should be in manner and form as directed in these instructions.

4. All bids and guaranties must be made in triplicate, upon printed forms to be obtained at this office.

5. The guaranty attached to each copy of the bid must be signed by an authorized surety company, or by two responsible guarantors, to be certified

as good and sufficient guarantors by a Judge or clerk of a United States Court, United States District Attorney, United States Commissioner, or Judge or clerk of a State court of record, with the seal of said court attached.

6. A firm as such will not be accepted as surety, nor a partner for a copartner or firm of which he is a member. Stockholders who are not officers of a corporation may be accepted as sureties for such corporation. Sureties, if individuals, must be citizens of the United States.

7. When the principal, a guarantor, or a surety, is an individual, his signature to a guaranty or bond shall have affixed to it an adhesive seal. Corporate seals will be affixed by corporations, whether principals or sureties. All signatures to proposals, guaranties, contracts, and bonds should be written out in full, and each signature to guaranties, contracts, and bonds should be attested by at least one witness, and, when practicable, by a separate witness to each signature.

8. Each guarantor will justify in a sum of two thousand five hundred (\$2,500) dollars. The liability of the guarantors and bidder is determined by the Act of March 3, 1883, 22 Statutes, 487, Chap. 120, and is expressed in the guaranty attached to the bid.

9. A proposal by a person who affixes to his signature the word "president," "secretary," "agent," or other designation, without disclosing his principal, is the proposal of the individual. That by a corporation should be signed with the name of the corporation, followed by the signature of the president, secretary or other person authorized to bind it in the matter, who should file evidence of his authority to do so. That by a firm should be signed with the firm name, either by a member thereof or by its agent, giving the names of all members of the firm. Anyone signing the proposal as the agent of another or others, must file with it legal evidence of his authority to do so.

10. The place of residence of every bidder, and post-office address, with county and state, must be given after his signature.

11. All prices must be written as well as expressed in figures.

12. One copy each of the advertisement, the instructions for bidders, and the specifications, all of which can be obtained at this office on application by mail or in person, must be securely attached to each copy of the proposal and be considered as comprising a part of it.

13. Proposals must be prepared without assistance from any person employed in or belonging to the military service of the United States or employed under this office.

14. No bidder will be informed, directly or indirectly, of the name of any person intending to bid or not to bid, or to whom information in respect to proposals may have been given.

15. All blank spaces in the proposal and bond must be filled in, and no change shall be made in the phraseology of the proposal, or addition to the items mentioned therein. Any conditions, limitations, or provisos attached to proposals will be liable to render them informal and cause their rejection.

16. Alterations by erasure or interlineation must be explained or noted in the proposal over the signature of the bidder.

17. If a bidder wishes to withdraw his proposal he may do so before the time fixed for the opening without prejudice to himself, by communicating his purpose in writing to the officer who holds it, and, when reached, it shall be handed to him or his authorized agent, unread.

18. No bids received after the time set for opening of proposals will be considered.

19. The proposals and guaranties must be placed in a sealed envelope marked "Proposals for DREDGING OLYMPIA HARBOR, to be opened December 18, 1902," and inclosed in another sealed envelope addressed to MAJOR JOHN MILLIS, Corps of Engineers, but otherwise unmarked. It is suggested that the inner envelope be sealed with sealing wax.

20. It is understood and agreed that the quantities given are approximate only, and that no claim shall be made against the United States on account of any excess or deficiency, absolute or relative, in the same. Bidders, or their authorized agents, are expected to examine the maps and drawings in this office, which are open to their inspection, to visit the locality of the work, and to make their own estimates of the facilities and difficulties attending the execution of the proposed contract, including local conditions, uncertainty of weather, and all other contingencies.

21. The United States reserves the right to reject any and all bids, and to waive any informality in the bids received; also to disregard the bid of any failing bidder or contractor known as such to the Engineer Department; or any bid which is palpably unbalanced or obviously below what the work can be done for; or the bid of any bidder who shall fail to produce, when called upon to do so, evidence satisfactory to the Engineer Officer in charge of the said bidder's ability to do the contemplated work within the required time, including his control of the necessary means and equipment. The failure of a bidder to make satisfactory progress, or to complete on time similar work under previous contracts with the United States, will be duly considered in canvassing bids, and may be a valid cause for the rejection of his proposal. Reasonable grounds for supposing that any bidder is interested in more than one bid for the same item will cause the rejection of all bids in which he is interested.

22. The bidder to whom award is made will be required to enter into written contract with the United States, with good and approved security, in an amount of five thousand (\$5,000) dollars, within ten (10) days after being notified of the acceptance of his proposal. The contract which the bidder and guarantors promise to enter into shall be, in its general provisions, in the form adopted and in general use by the Engineer Department of the Army, blank forms of which can be inspected at this office, and will be furnished, if desired, to parties proposing to put in bids. Parties making bids are to be understood as accepting the terms and conditions contained in such form of contract.

23. The sureties, if individuals, are to make and subscribe affidavits of justification on the back of the bond to the contract, and they must justify in amounts which shall aggregate double the amount of the penal sum named in the bond.

24. Bidders are invited to be present at the opening of the bids.

GENERAL CONDITIONS.

25. A copy of the advertisement, and of the specifications, instructions and conditions, will be attached to the contract and form a part of it.

26. The contractor should, within ten days from the award of the contract, furnish the office with the postoffice address to which communications should be sent.

27. Transfers of contracts, or of interests in contracts, are prohibited by law.

28. The contractor will not be allowed to take advantage of any error or omission in these specifications as full instructions will always be given should such error or omission be discovered.

29. The decision of the Engineer Officer in charge as to quality and quantity shall be final.

30. Payments will be made monthly for material removed over those portions of the channel and basin where full depth has been secured and maintained during the month. A percentage of ten (10) per centum will be reserved from each payment until final completion of the work.

31. The contractor will be required to prosecute the work with faithfulness and energy, and he will be required to complete it within eight calendar months after the date of notification of approval of the contract by the Chief of Engineers, U. S. Army.

32. Unless extraordinary and unforeseeable conditions supervene, the time allowed in these specifications for the completion of the contract to be entered into is considered sufficient for such completion by a contractor having the necessary plant, capital and experience. If the work is not completed within the period stipulated in the contract, the Engineer Officer in charge may, with the prior sanction of the Chief of Engineers, waive the time limit, and permit the contractor to finish the work within a reasonable period, to be determined by the said Engineer Officer in charge. Should the original time limit be thus waived, all expenses for inspection and superintendence and other actual loss and damages to the United States due to the delay beyond the time originally set for completion shall be determined by the said Engineer Officer in charge, and deducted from any payments due or to become due to the contractor: *Provided, however*, that the party of the first part may, with the prior sanction of the Chief of Engineers, waive for a reasonable period the time limit originally set for completion, and remit the charges for expenses of superintendence and inspection for so much time as, in the judgment of the said Engineer Officer in charge, may actually have been lost on account of unusual freshets, ice, rainfall, or other abnormal force or violence of the elements, or by epidemics, local or State quarantine restrictions, or other unforeseeable cause of delay arising through no fault of the contractor, and which prevented him from commencing or completing the work or delivering the materials within the period required by the contract: *Provided, further*, that nothing in these specifications shall affect the power of the party of the first part to annul the contract as provided in the form of contract adopted and in use by the Engineer Department of the Army.

33. The contractor will be required to hold the United States harmless against all claims for the use of any patented article, process, or appliance in connection with the contract herein contemplated.

SPECIAL CONDITIONS.

34. The dredging to be done consists in completing the excavation of a channel extending from deep water in Budd Inlet to the city wharves a distance of about 8,600 feet, with a turning basin at the inner end.

35. The channel when completed will have a bottom width of 250 feet, a depth of twelve feet below mean lower low water and side slopes not steeper than 1 horizontal to 1 vertical. The turning basin will be of the dimensions shown on the drawing herewith and it will have the same depth and side slopes as the channel.

36. The material to be excavated is believed to be mud and sand, but no guaranty can be given as to its character. All available information in the possession of the Engineer Officer in charge concerning the work will be given intending bidders upon application.

37. The quantity of material to be removed is estimated at 55,000 cubic yards measured in place.

Should the amount available not be sufficient to complete the channel and basin as above, a narrower channel of full depth, and the basin of full depth and size, will be excavated.

38. The present depths of water over the area to be dredged range from 29 feet to 18 feet below the plane of high water. The depth of material to be excavated will vary from 0 to 9 feet. The extreme range of tide is $20\frac{1}{2}$ feet.

39. The limits of dredging will be given by agents of the United States, and dredging done outside the prescribed limits will not be paid for. No additional allowance or payment will be made for additional excavation or other work, service, or material, that may be necessary to secure a channel and basin of the clear dimensions specified and shown on the drawings.

40. The contractor will be required to supply, place, and maintain, at his own expense, the necessary approved stakes, piles, tide gauges, lines, anchors, buoys, flags, etc., for marking the ranges and limits of dredging. All stakes, piling, dolphins, or other auxiliary structures which it may be necessary to place or erect in connection with the dredging work shall be removed by the contractor at his own expense when any such piling, etc., becomes no longer needed, or before the final completion of the contract, as may be required by the Engineer Officer in charge.

41. The dredged material is to be deposited in deep water in Budd Inlet on Puget Sound where it will reach depths not less than 50 feet at extreme low water; or the material may be deposited on the land side of established harbor lines of Olympia Harbor as may be arranged between the contractor and owners of lands on which such deposit is made, if suitable bulkheads are provided or other dispositions are made to insure that the material will not find its way to the channel or harbor side of such lines. Any arrangement for disposing of dredged material other than by deposit in deep water of Budd Inlet is to be subject to the approval of the Engineer Officer in charge.

42. Snags, piles, boulders, or other obstructions that may be encountered in the area to be dredged shall be removed by the contractor and disposed of as may be approved by the Engineer Officer in charge without extra compensation.

43. Dredging is to begin at the outer or northern end of the channel, and the channel is to be excavated to full dimensions as the work progresses

southward. If in addition the contractor desires to put other dredgers at work on the inner portions of the channel, this may be done.

44. The contractor must be either present on the work while it is in progress or be represented by a competent person having immediate charge of the work with full authority to receive and act upon instructions that may be given by the Engineer Officer in charge or his authorized representative.

45. Government inspectors are not authorized to waive or alter in any respect any of the terms or requirements of the contract, to make additional requirements, to grant extensions or delays, or to waive forfeitures. The contractor shall not be entitled to payment for any improper work accepted or allowed by an inspector.

46. Payment will be made by the cubic yard of the original volume occupied by the excavated material within the channel and basin limits herein specified, as determined by surveys and calculations made under direction of the Engineer Officer in charge.

47. Should filling occur due to the plant or methods of the contractor during the progress of the work the contractor is to clear the channel and basin to full dimensions without extra compensation before final acceptance and payment.

48. The acceptance, approval of, or payment for any portion of the work under this contract shall not release the contractor from the obligation to secure at the contract price the full required depth, width and side slopes in that part before the completion and final acceptance of the work as a whole.

49. The work must be so conducted as to interfere as little as practicable with present uses of the channel. The contractor shall display suitable lights each night between sunset and sunrise upon his vessels.

50. The United States will not be responsible for any damage or injury to the contractor's employees, plant or materials, or for any damage done by or to them from any source or cause.

51. No work shall be done on Sundays or on legal National holidays, except in case of emergency. No work shall be done between sunset and sunrise unless the contractor receives special written authority from the Engineer Officer in charge. Any work done in violation of these requirements shall not be estimated or paid for.

52. Any doubt as to the meaning of the specifications and any obscurity in the wording of them will be explained by the Engineer Officer in charge, who shall have the right to correct any errors or omissions in them when such correction is necessary for the proper fulfillment of their intention.

In case his interpretation is objected to by the contractor, the latter may appeal to the Chief of Engineers.

53. If the contractor has any claim to make against the United States on account of this contract, he shall file it with the Engineer Officer in charge before final payment is made, stating in detail reasons, quantities and amounts. Otherwise the receipt for the final payment shall state that the account is correct and just, and in full for all work done, material furnished and services rendered under or in connection with the contract.

54. By the Engineer Officer in charge, as used in these specifications, is meant the officer who signs this contract on behalf of the United States or his duly appointed successor.

55. Should any employee of the contractor be, in the opinion of the Engineer Officer in charge, incompetent or disorderly, or evade the orders and instructions given him, he shall be immediately discharged upon the request of the Engineer Officer in charge and not re-employed on the work. Such discharge, however, shall not form the basis of any claim for compensation or damages against the United States or any of its officers or agents.

Proposal for Dredging.

....., 1902.
 To MAJOR JOHN MILLIS,
 Corps of Engineers, U. S. Army,
 Seattle, Washington.

SIR:

In accordance with your advertisement of November 15, 1902, inviting "Proposals for DREDGING OLYMPIA HARBOR, WASH.," and subject to all the conditions and requirements thereof, and of your specifications for the same, dated November 15, 1902, copies of both of which are hereto attached, and, so far as they relate to this proposal, are made a part of it, we (or) I propose to do the dredging at the rate of (.....) cents per cubic yard.

.....

 We (or) I make this proposal with a full knowledge of the kind and quantity of the work required, and, if it is accepted, will, after receiving written notice of such acceptance, enter into contract within the time designated in the specifications, with good and sufficient sureties for the faithful performance thereof.

(Signature).....

(Address).....

(Signature).....

(Address).....

(Signed in Triplicate.)

Guaranty to Accompany Proposal.

(For a Corporation.)

The, a corporation existing under the laws of the State of, hereby undertake that if the bid of herewith accompanying, dated, 1902, for DREDGING OLYMPIA HARBOR, WASH., be accepted as to any or all of the services proposed to be furnished thereby, or as to any portion of the same, within sixty days from the date of the opening of proposals therefor, the said bidder will, within ten (10) days after notice of such acceptance, enter into contract with the proper officer of the United States to do such dredging and such services of those proposed to be furnished by said bid as shall be accepted, at the

prices offered by said bid and in accordance with the terms and conditions of the advertisement inviting said proposals, and will give bond with good and sufficient surety or sureties, as may be required, for the faithful and proper fulfillment of such contract. And said corporation hereby binds itself and its successors to pay to the United States, in case the said bidder shall fail to enter into such contract or give such bond within ten (10) days after said notice of acceptance, the difference in money between the amount of the bid of said bidder on the services so accepted and the amount for which the proper officer of the United States may contract with another party to furnish said services, if the latter amount be in excess of the former.

IN WITNESS WHEREOF, The name and corporate seal of said corporation has been hereto affixed this.....day of 1902, and these presents duly signed by its* pursuant to a resolution of its†..... passed on the day of A. D., a copy of the record of which is on file in the War Department.

Attest:

..... By..... ‡

(Executed in Triplicate.)

* The president or officer authorized to sign for the corporation.

† The board of directors or other governing body of the corporation.

‡ Here affix the corporate seal.

Guaranty to Accompany Proposal.

(For Individuals.)

We..... of in the County of and State of and of in the County of and State of hereby undertake that if the bid of herewith accompanying, dated..... 1902, for DREDGING OLYMPIA HARBOR, WASH., be accepted as to any or all of the services proposed to be furnished thereby, or as to any portion of the same, within sixty days from the date of the opening of proposals therefor, the said bidder will, within ten (10) days after notice of such acceptance, enter into a contract with the proper officer of the United States to do such dredging and such services of those proposed to be furnished by said bid as shall be accepted, at the prices offered by said bid and in accordance with the terms and conditions of the advertisement inviting said proposals, and will give bond with good and sufficient sureties for the faithful and proper fulfillment of such contract. And we bind ourselves, our heirs, executors and administrators, jointly and severally, to pay to the United States, in case the said bidder shall fail to enter into such contract or give such bond within ten (10) days after said notice of acceptance, the difference in money between the amount of the bid of said bidder on the services so accepted and the amount for which the proper

officer of the United States may contract with another party to furnish said services, if the latter amount be in excess of the former.

Given under our hands and seals this day of,
nineteen hundred and two.

In presence of

..... as to *

..... as to *

(In Triplicate.)

* Affix adhesive seal.

STATE OF }
County of } ss.

I,, one of the guarantors named
in the foregoing guaranty, do swear that I am pecuniarily worth the sum of
..... dollars, over and above all
my debts and liabilities.

Subscribed and sworn to before me this.....day of
....., 190 , at *

STATE OF }
County of } ss.

I,, one of the guarantors named in
the foregoing guaranty, do swear that I am pecuniarily worth the sum of
..... dollars, over and above all
my debts and liabilities.

Subscribed and sworn to before me thisday of,
190 , at *

I,†do hereby certify that
.....and....., the guarantor above
named,personally known to me, and that, to the best of my
knowledge and belief, ‡ is pecuniarily worth, over and above
all his debts and liabilities, the sum stated in the accompanying affidavit sub-
scribed by him.

I,, do hereby certify that.....
....., the guarantor above named, is personally known to
me, and that, to the best of my knowledge and belief, he is pecuniarily worth,
over and above all his debts and liabilities, the sum stated in the accompanying
affidavit subscribed by him.

* The oath to be taken before a United States Commissioner, a clerk of a United States Court, notary public or some other officer having general authority to administer oaths. If the officer has an official seal it must be affixed, otherwise the proper certificate as to his official character must be furnished.

† This certificate to be by a judge or clerk of a United States Court, a United States district attorney, a United States Commissioner, or a judge or clerk of a State court of record with the seal of said court attached. If the official can make the certificate as to both sureties, it will not be necessary to fill out the next form below.

‡ He or each.

***Specification for Constructing Road into Mount Rainier
National Park, Wash.***

Advertisement.

U. S. ENGINEER OFFICE,

ROOM 602 BURKE BUILDING, SEATTLE, WASH.

July 20, 1904.

Sealed proposals for constructing road into Mount Rainier National Park will be received at this office until 12 M., August 3, 1904, and then publicly opened. Specifications, blank forms, and all available information will be furnished on application at this office, or to the Assistant Engineer's office, Berlin Building, Tacoma, Wash.

JOHN MILLIS, Maj. Engrs.

SPECIFICATIONS.

GENERAL INSTRUCTIONS FOR BIDDERS.

[Practically the same as in the advertisement for bids on the Olympia Harbor dredging work. See page 59]

SPECIAL CONDITIONS.

34. The proposed road is to extend from the west boundary of the National Park Reserve to Camp of the Clouds. It will have, generally, a four per cent gradient between Longmire Springs and Camp of the Clouds, a distance of about 15 miles. From Longmire Springs down to the west boundary of the reserve, a distance of about 10 miles, the gradient will average less than two per cent.

35. Under this contract a road will be constructed from the vicinity of Longmire Springs as directed, and extending towards Camp of the Clouds as far as may be possible with the funds available. This amount is about \$22,000.00.

36. The work in general consists in clearing, grubbing, excavating, filling, ditching, draining, bridging, compacting earthwork, and such other work as may be necessary to construct a first-class earth road. The price bid for each class of work shall be full compensation for furnishing all labor, material and tools of every description and for doing all work herein specified, to the satisfaction of the Engineer Officer in charge.

CLEARING.

37. Roadway will be cleared as defined on the ground by stakes to be set by the Government agent. The width of clearing will generally be 30 feet on each side of center line of proposed road, though it may be necessary to increase this width along steep sidehill cuts. All rotting fallen and standing trees, stumps, brush and other vegetation shall be cut off at the general level of the surrounding ground, except such as may, in the opinion of the Government agent, be desirable to leave, and shall be destroyed or removed beyond eyesight from the road. Proper care must be taken not to injure or mar those left standing. Clearing will be paid for per acre from measurements made of the area actually cleared.

Dangerous trees, liable, in the opinion of the Government agent in charge, to fall across road, when outside of the area to be cleared, must be felled and removed from the roadway by the contractor without extra compensation.

GRUBBING.

38. A strip 13 feet in width on each side of the center line throughout the whole distance and in cuts between slope stakes shall be grubbed by removing the stumps, roots and decaying vegetable matter and disposing of them as in paragraph 37, except that grubbing may be omitted at the discretion of the Government agent in charge when the natural surface of the ground is more than two feet below sub-grade. Grubbing will be paid for per acre, the price to include the obliteration of all unsightly holes lying without the area to be graded caused by removal of stumps, etc.

EXCAVATION.

39. All black and mucky loam shall be removed from the area to be graded both in cut and fill, and be disposed of by spreading evenly in the clearing as directed. A small quantity of little twigs, sod and other vegetable mould will be permitted in embankments, except where grade passes from cut to fill.

40. Grading in cut and fill shall be done to sub-grade, four inches below finished grade at the center of road. Sub-grade shall be completed to required cross section with its surface left free from stones larger than 2 inches in diameter. Boulders and other rock appearing or known to exist must be removed to a depth of 9 inches below sub-grade.

41. All embankments to be made with excavated material spread in layers not more than 9 inches in thickness. Each layer to be rolled if embankment is formed by "casting." When earth is brought to final height it must be harrowed, then trimmed by means of a road machine or scraping grader, and ultimately rolled to a hard and smooth surface, the cross section of the roadway to be maintained during this process by addition of earth as needed.

42. All earth taken from cuts shall be used in bringing road to sub-grade and in filling along roadway, either in widening it uniformly or in increasing its width at curves as directed.

43. All cuts and fills to be left even and regular, conforming in shape to the alignment of the road, and in slope to that shown on cross sections. Earth cuts to have slopes generally not steeper than 1 on 1; earth fills to have slopes not steeper than 1 on $1\frac{1}{2}$; rock cuts may have vertical face the toe to be not less than 13 feet distant from center of road.

44. Side ditches shall have a uniform grade and be formed as shown on cross sections.

45. Earthwork will include material of every class and nature not otherwise specified and will be paid for by the cubic yard measured in excavation. The price paid shall include the preparation of the ground for filling as in paragraph 39; excavating, delivering and forming into embankment, shaping, trimming and compacting road (as in paragraphs 40, 41, 42, and 43); forming side ditches as in paragraph 44; and all other labor and expenses incidental to the handling of excavated material not otherwise provided for, all in conformity with the cross section and lines given.

46. Rock work will include only such rock in ledges as cannot be removed without blasting and will be paid for by the cubic yard, measured in excavation from lines given by the Government agent after it is stripped with pick. The price to be paid for rock excavation shall include its removal, (a) as provided for clearing in paragraph 37; (b) to toe of fill in that vicinity and piling solidly in retaining wall form or (c) and piling within the cleared area as the Government agent may direct.

47. The removal of detached pieces of rock and boulders of every size, even though they may require blasting, also of all material as hard as rock, but not commonly called rock, shall be included in the bid for earthwork.

RETAINING WALLS.

48. Retaining walls of dry, uncoursed, well scabbled rubble shall be built of native rock in conformity with plans and sections furnished by the Government agent at such places as he will designate. They will be paid for in place by the cubic yard, computed from the measurements made of the wall as actually built, except that payment will not be made for greater section than that called for on the drawings.

UNDER DRAINS.

49. When required by the Government agent in charge, drain tile shall be placed at a depth of not less than 18 inches below the side ditch along upper side of road. This shall be laid carefully with close joints and uniform grade. It may also be required at retaining walls, in which case it will be laid through the wall as directed. In both cases the tiling will be paid for in place by the lineal foot. Trench work for tiling will be paid for by the cubic yard, measured from sub-grade, or from natural surface if below sub-grade, in excavation, price to include back filling and removal of surplus material.

CROSS DRAINS.

50. When required by the Government agent the upper side ditch or under drain, or both, shall be drained to lower side of road through sewer pipe laid on a uniform grade with tight cement mortar (one part Portland cement and two parts sand) joints, at an angle of 30 degrees with the road in the natural surface of the ground, the top of pipe to be not less than one foot below sub-grade.

The inlet shall consist of a regulation sewer pipe "Y" branch, the open ends to be surrounded with a cluster of cobble stones through which the under drain and side ditch will pass, the latter being dammed with rock to direct the water into the cross drain and to protect the end of the "Y" branch.

The outlet projecting through the roadway shall be protected with a similar cluster of stones placed in retaining wall form and backed with earth.

Cross drains will be paid for by the lineal foot in place, measured along center line of pipe, price to include necessary excavation and back fill and inlet and outlet protection.

CATCH WATER DITCHES.

51. Catch water ditches, when required by the Government agent, shall be excavated not less than eight feet distant from slope stakes in sidehill cut. They will be made to an established grade; will generally have a bottom width of 18

inches and slopes of 1 on 1; the excavated material to be banked on the lower side of the ditch, or may be disposed of as for earthworks, as the Government agent may elect. These will be paid for by the cubic yard from measurements in excavation, price to include disposal of earth.

52. Should it be necessary to excavate a trench beyond the limit of slope stakes in order to direct drainage away from the roadway, the trench shall have a bottom width of 18 inches and side slopes of 1 on 1½. This will be paid for as catch water ditches under paragraph 51 from measurements in excavation, except that price bid will include earth disposal by equal distribution over adjacent surface instead of being banked.

CORDUROY.

53. Corduroy to be used at the discretion of the Government agent across wet and boggy places shall consist of straight saplings not more than 8 inches in diameter at the butt, and length 18 inches longer than the distance between slope stakes where used. They shall be laid close together in two horizontal layers at right angles to the direction of the road, with upper side not less than 9 inches below sub-grade, with butts and tips alternating. It will be paid for in place by the lineal foot of completed work measured along the center of the road.

CULVERTS AND BRIDGES.

54. Culverts of sewer pipe or wood and short span bridges of wood shall be placed across beds of small streams and springs and at other points as directed. When made of sewer pipe they shall be laid same as cross drains, except that the angle made with road may be varied (no special grade will be required), and shall be covered with at least 18 inches of dirt. When made of wood they may be of hewed cedar spiked to stringers, in which case the upper side of wood work shall be placed not less than 9 inches below sub-grade, or of sawed fir and cedar, placed at grade as directed by and in accordance with the plans of the Government agent.

If of sewer pipe they will be paid for same as cross drains; otherwise by the thousand feet, board measure, price to include all material of whatsoever kind, except drift bolts. Drift bolts will be paid for by the pound in place. The crossings at Van Trump Creek and Nisqually River are specifically excepted from the work required in this paragraph.

SURFACING.

55. Surfacing of volcanic ash or other material acceptable to the Government agent in charge shall be placed on and cover the road to a depth when compressed of four inches at the crown, tapering to two and one half (2½) inches at the side ditches, as shown on cross sections. This shall be placed in two layers, each layer thoroughly compacted with a roller of approved pattern, not less than ten tons in weight, and sprinkled during the process, if deemed necessary by the Government agent to obtain the desired hardness, adding enough material to bring the surface of the finished road to grade. This will be paid for in place by the square yard.

CROSS SECTIONS.

56. The cross sections shown herein are to be considered as types that may be modified to suit the conditions. Working cross sections will be prepared in advance of the work and may vary from those shown in (a) width at curves, (b) area of side ditches, (c) absence of under drains, (d) absence of catch water ditches, (e) variation in slopes.

57. All work shall conform to the lines, grades, limits, etc., fixed by the Government agent, and work done outside of these lines, grades, etc., will not be paid for.

58. The route will be divided into sections of convenient length, and the contractor may be required to give the Government agent written notice 24 hours in advance of his intended opening of any new work or section.

59. The contractor shall furnish at his own expense the stakes required to lay off the work, as well as the axmen required to set and place them.

60. The contractor must be either present on the work while it is in progress or be represented by a competent person having immediate charge of the work, with full authority to receive and act upon instructions that may be given him.

61. Government agents are not authorized to waive or alter in any respect any of the terms or requirements of the contract, to make additional requirements, to grant extensions or delays, or to waive forfeitures. The contractor shall not be entitled to payment for any improper work accepted or allowed by an agent.

62. Payment will be made as herein specified from measurements and calculations made under direction of the Engineer Officer in charge.

63. Should the bridges at Van Trump Creek and Nisqually River not be in place when road is completed to these crossings, the contractor may suspend work at these points temporarily until crossing is completed, provided it is so completed prior to the termination of his work for the season.

64. The United States will not be responsible for any damage or injury to the employers' employees, plant or materials, or for any damage done by or to them from any source or cause.

65. No work shall be done on Sundays or on legal national holidays, except in case of emergency. Any work done in violation of this requirement shall not be estimated or paid for.

66. Any doubt as to the meaning of the specifications and any obscurity in the wording of them will be explained by the Engineer Officer in charge, or his representative. The Engineer Officer in charge shall have the right to correct any error or omissions in them when such correction is necessary for the proper fulfillment of their intention. In case his interpretation is objected to by the contractor the latter may appeal to the Chief of Engineers.

67. No other work than that directed or authorized by the Engineer Officer in charge shall be done, either upon the site of the work or in its vicinity, nor shall any building be erected or trees cut down or any other natural features of the park and reserve be changed without proper written authority.

68. Within ten days after the completion of the work and before final payment is made, the contractor must remove and dispose of all buildings, shacks, unused material and rubbish, from every portion of the park and reserve with

which he has been connected under this contract, to the satisfaction of the Government agent. During the progress of the work the grounds are to be kept in a neat and workmanlike condition, and the contractor's employees are to be required to obey proper police and sanitary regulations.

69. The contractor shall give notice to the Government agent when he intends to fire any portion of the brush, etc., on the area to be cleared, and will be held liable for any damage done to trees, etc., in the park and reserve by fires kindled by him or his employees.

70. All timber that may be cut and all other material of value that may result from the work remains the property of the United States.

QUANTITIES.

71. For the purpose of canvassing the bids the following quantities will be assumed, viz.:

Clearing	Acres	32
Grubbing	Acres	14
Earthwork	Cubic yards	30,000
Rockwork	Cubic yards	300
Retaining walls	Cubic yards	220
Under drains, tiling	Lineal feet	200
Trench work	Cubic yards	100

Cross Drains.

Sewer pipe	Lineal feet, 12 in	510
Sewer pipe	Lineal feet, 18 in	220
Catch water ditches	Cubic yards	2,000
Corduroy	Lineal feet	200

Culverts and Bridges.

Lumber	Feet, B. M.	100,000
Wrought iron	Pounds	100
Surfacing	Square yards	43,000

The right is reserved to omit such of the above as may be found necessary or advisable to keep the expenditure within the limits of the funds available, and surfacing will be considered first for omission.

72. If the contractor has any claim to make against the United States on account of this contract, he shall file it with the Engineer Officer in charge before final payment is made, stating in detail reasons, quantities and amounts. Otherwise the receipt for the final payment shall state that the account is correct and just, and in full for all work done, material furnished and services rendered under or in connection with the contract.

73. Should any employee of the contractor be, in the opinion of the Engineer Officer in charge, incompetent or disorderly, or evade the orders and instructions given him, he shall be immediately discharged upon the request of the Engineer Officer in charge, and not re-employed on the work. Such discharge, however, shall not form the basis of any claim for compensation or damages against the United States or any of its officers or agents.

74. By the Engineer Officer in charge, as used in these specifications, is meant the officer who signs this contract on behalf of the United States, or his duly appointed successor.

Proposal for Constructing Road into Mount Rainier National Park, Wash.

To MAJOR JOHN MILLIS, , 1904.
 Corps of Engineers, U. S. Army,
 Seattle, Washington.

SIR:

In accordance with your advertisement of July 20, 1904, inviting proposals for constructing road into Mount Rainier National Park, Wash., and subject to all the conditions and requirements thereof, and of your specifications for the same, dated July 20, 1904, copies of both of which are hereto attached, and, so far as they relate to this proposal, are made a part of it, we (or) I propose to furnish all the necessary materials, labor, machinery and appliances, and to do the specified work at the following prices:

Clearing	dollars and	cents per acre
Grubbing	dollars and	cents per acre
Earthwork		Cents per cubic yard
Rockwork		Cents per cubic yard
Retaining walls		Cents per cubic yard

Under Drains:

4-inch tile	Cents per lineal foot
5-inch tile	Cents per lineal foot
6-inch tile	Cents per lineal foot
8-inch tile	Cents per lineal foot
Trench work	Cents per cubic yard

Cross Drains and Culverts:

10-inch sewer pipe	Cents per lineal foot
12-inch sewer pipe	Cents per lineal foot
14-inch sewer pipe	Cents per lineal foot
20-inch sewer pipe	Cents per lineal foot
24-inch sewer pipe	Cents per lineal foot
Catch water ditches	Cents per cubic yard
Corduroy	Cents per lineal foot

Culverts and Bridges:

Hewed timber	dollars and	cents per 1,000 ft., B. M.
Sawed lumber	dollars and	cents per 1,000 ft., B. M.
Wrought iron		Cents per pound
Surfacing		Cents per square yard

We (or) I make this proposal with a full knowledge of the kind and quantity of the work required, and, if it is accepted, will, after receiving written notice of such acceptance, enter into contract within the time designated in the specifications, with good and sufficient sureties for the faithful performance thereof.

(Signature)

(Address)

(Signature)

(Address)

(Signed in Triplicate.)

Guaranty to Accompany Proposal.

(For a Corporation.)

[Practically the same as in the advertisement for bids on the Olympia Harbor dredging work.]

Specification No. 1432 for Extension of Quay Wall West of Dry Dock at the U. S. Navy Yard, Puget Sound, Wash.

UNDER APPROPRIATION "NAVY YARD, PUGET SOUND, WASH.;
QUAY WALL, EXTENSION."

Act Approved April 27, 1904.

GENERAL PROVISIONS.

1. *Intention.* — It is the declared and acknowledged intention and meaning to provide and secure an extension to the concrete quay wall on the west side of the dry dock to a point beyond wharf No. 2, as shown on the accompanying plans.

2. *Contract.* — The contract to cover the work to be done will be based upon this specification and the plans to which it refers, which will be attached to and form a part thereof.

3. *Omissions and misdescriptions.* — The omission from the contract, or from the plans, specification, or other papers attached thereto and forming a part thereof, or the misdescription of any details of work, the proper performance of which is necessary to carry out fully the intention above expressed, shall not operate to release the contractor from performing such work, but the same shall be fully and properly performed in the same manner as if fully and correctly shown, described, and required in and by the contract, and without expense to the United States in addition to the contract price.

4. *Discrepancies.* — Should any discrepancy exist between plans and specification, or any parts of either, or should the language of any part of the contract be ambiguous or doubtful, the civil engineer or other officer or agent of the United States in charge of the work shall decide as to the true intent and meaning, subject only to appeal to the Chief of the Bureau of Yards and Docks.

5. *Control of work.* — The United States, by its officer in charge of the work or other authorized representative, shall at all times have full control and direction of all work under the contract, and all questions, disputes, or differences as to any part or detail thereof shall be decided by such officer or representative, subject only to appeal to the Chief of the Bureau of Yards and Docks.

6. *Facilities.* — The contractor will be allowed reasonable space at the site of the work and access to the same for receiving, handling, storing, and working material, but he shall confine both employees and material to the space assigned. Upon the completion of the work, and before final payment on account of the same, the contractor shall remove all of his surplus material, machinery, tools, etc., from the naval station.

7. *Employees.* — The contractor shall employ only competent, careful, orderly persons upon the work, and if, at any time, it shall appear to the officer in charge that any person employed upon the work is incompetent, careless, reckless, or disorderly, or disobeys or evades orders or instructions, or shirks his duty, such person shall be immediately discharged from and not again employed upon the work.

8. *Time of commencement of work.*—The contractor shall commence work immediately after the execution of the contract, and continue without interruption, unless otherwise directed by the United States by its officer in charge of the work or other authorized representative, or otherwise herein-after provided.

9. *Time of completion.*—The entire work shall be completed in every respect and particular within seven calendar months from the date of the contract.

10. *Extension of time.*—Extensions of time for the completion of the work may be allowed and made, in writing, by the Chief of the Bureau of Yards and Docks. Any and every extension of time must be specifically made and shall not be implied from any cause under any circumstances.

11. *Continuance of work after time.*—It is mutually understood and agreed that in the event of the work not being completed within the time allowed by this contract, said work shall continue and be carried on according to all the provisions of said contract, plans, and specification, unless otherwise at any time directed by the party of the second part, in writing, and said contract shall be and remain in full force and effect during the continuance and until the completion of said work, unless sooner revoked or annulled according to its terms: *Provided*, That neither an extension of the time beyond the date fixed for the completion of said work nor the permitting or accepting of any part of the work after said date shall be deemed to be a waiver by the party of the second part of its right to annul or terminate said contract for abandonment or failure to complete within the time specified in paragraph 9, or to impose and deduct damages as hereinafter provided.

12. *Damages for delay.*—In case the work is not completed within the time specified in paragraph 9, or the time allowed by the Chief of the Bureau of Yards and Docks under paragraph 10 of this specification, it is distinctly understood and agreed that deductions at the rate of \$5 per day shall be made from the contract price as liquidated damages, and not as penalty, for each and every calendar day after and exclusive of the date within which completion was required, up to and including the date of completion and acceptance of the work, said sum being specifically agreed upon in advance as the measure of damage to the United States by reason of delay in the completion of the work; and the contractor agrees and consents that the contract price, reduced by the aggregate of damages so deducted, shall be accepted in full satisfaction for all work done under the contract.

13. *Unavoidable delays.*—Unavoidable delays are such as result from causes which are undoubtedly, or may reasonably be presumed to be, beyond the control of the contractor, such as acts of Providence, unusual storms, fires (not the result of negligence), fortuitous events, inevitable accidents, etc. Delays caused by acts of the United States will also be regarded as unavoidable delays. Should the progress of the work be, or seem likely to be, delayed at any time by such causes, the contractor shall at once notify the officer in charge, in writing, of the occurrence, in order that a record of the same may be made. Should it be decided that

the delay was unavoidable, a corresponding extension of time for the completion of the work may be allowed, but it is distinctly understood that should the contractor fail or neglect to notify the officer in charge as above provided, such omission shall be construed as a waiver of all claim and right to an extension of time for the completion of the work on account of such delay.

14. *Avoidable delays.*— Avoidable delays are such as result from causes which the contractor might, by care, prudence, or foresight, have guarded against or prevented. No extension of time will be allowed on account of such delays.

15. *Progress of work.*— If at any time the progress of the work shall, in the opinion of the officer in charge, appear to have been such as to indicate that the work is not likely to be completed within the time allowed, he shall report such opinion to the Chief of the Bureau of Yards and Docks, who may, in his discretion, declare the contract null and void, without prejudice to the right of the United States to recover for defaults therein or violations thereof.

16. *Annulment of contract.*— Should the contract for any reason be declared null and void, the contractor shall thereupon become indebted to the United States as for ascertained and liquidated damages in a sum equal to the aggregate of all payments made to him on account of the contract, and undertakes and promises to refund the same to the United States on demand. And the contractor shall further agree that the United States may hold all material delivered and work done under the contract and all machinery, tools, appliances, etc., upon the site of the work or used in connection therewith pending the completion of the work covered by the contract. Upon the annulment of the contract, a board of officers, or other representatives of the United States, shall be appointed, which shall ascertain and determine the value of all material delivered and work done, including a fair and reasonable margin of profit thereon, and upon the approval of the findings of said board by the Chief of the Bureau of Yards and Docks, he may proceed to complete the work according to the contract in such manner and by such means as he may deem advisable, and may, in his discretion, use or employ any material, tools, machinery, appliances, etc., belonging to or furnished by the contractor for use in connection with the work covered by the contract. Upon the completion of the work the total cost of completing the same shall be ascertained and determined by a similar board, and its findings, when approved by the Chief of the Bureau of Yards and Docks, shall be final and conclusive upon all parties; and should the total cost thereof exceed the contract price, the difference shall be charged to the contractor, who undertakes and promises to pay the same upon demand. Should the total cost of the work be less than the contract price, the contractor shall be entitled to receive the amount found by the board above mentioned to be the value of material delivered and work done by the contractor, less previous payments to him: *Provided*, That no allowance shall be made for profit which the contractor might have made by completing the work, or for any excess of the contract price over the total cost of the work.

17. *Changes.* — The United States reserves the right to make such changes in the contract, plans, and specification as may be deemed necessary or advisable by the Chief of the Bureau of Yards and Docks. Should any such changes affect the cost of the work by a sum greater than \$300, as estimated by the officer in charge, the same shall be ascertained by a board of not less than three officers to be appointed under the direction of the Chief of the Bureau of Yards and Docks; and the contractor shall agree and consent that the contract price, increased or decreased by the sum so ascertained, shall, if approved by the Chief of the Bureau of Yards and Docks, be accepted in full satisfaction for all work done under the contract. For all changes estimated to cost not more than \$300 the contractor shall in like manner accept the increased or decreased compensation as ascertained by the officer in charge of the work, and approved or revised by the Chief of the Bureau of Yards and Docks: *Provided*, That any changes determined upon as above shall be stipulated and agreed to, in writing, by the parties to the contract: *And provided further*, That the increased or decreased cost shall be the estimated actual cost to the contractor at the time of such estimate plus a profit of 10 per centum.

18. *Extras.* — The contract price shall cover all expenses, of whatever nature or description, connected with the work to be done under the contract. No allowance whatever will be made for additional or extra work or material except under the provisions of paragraph 17 of this specification.

19. *Verbal modifications.* — It is distinctly understood that no verbal statement of any person whomsoever shall be allowed in any manner or degree to modify or otherwise affect the terms of this specification or of the contract for the work. Changes shall be made only and strictly according to paragraph 17 of this specification.

20. *Patents.* — The contractor shall forever protect and defend the United States in the full and free use and enjoyment of any and all rights to any invention, machine, or device which may be applied as a part of the work, either in its construction or use after completion, against the demands of all persons whomsoever.

21. *Contractor's responsibility.* — The contractor shall be responsible for the entire work and every part thereof, and for all tools, appliances, and property of every description used in connection therewith. All methods of work, tools, and appliances shall be subject to inspection for safety and sufficiency, and allowance or rejection by the officer in charge: *Provided*, That the contractor shall specifically and distinctly assume all risks of damage or injury from any cause to property or persons used or employed on or in connection with the work, and of all damage or injury to any person or property, wherever located, resulting from any action or operation under the contract or in connection with the work, and undertakes and promises to protect and defend the United States against all claims on account of any such damage or injury.

22. *Contractor's supervision.* — The contractor shall give his personal attention to the work at all times, and shall be present, either in person or by a duly authorized representative, on the site of the work continually during its progress, to receive directions or instructions from the officer in charge.

SPECIAL PROVISIONS.

23. *Plans.* — Two sheets of plans, numbered $\frac{2-B}{60}$ sheets 1 and 2, and dated September, 1904, accompany this specification. This specification and the plans accompanying it shall be considered as supplementary one to the other, so that materials and workmanship shown, called for, or implied by the one and not by the other shall be supplied and worked into place the same as though specifically called for by both. All detail plans that may be furnished subsequently in further amplification, as well as all instructions given by the officer in charge that may be necessary to indicate more fully the intention of the specification and the above-mentioned plans, shall be followed and considered as though forming a part of the original contract. For all portions of the work the contractor shall submit the necessary detail plans to the officer in charge for approval, unless otherwise directed by him, before proceeding with the work. These details shall conform to the letter and spirit of the specification, to any supplementary data and instructions, and to the general and detail plans already furnished to the contractor. Plans shall be submitted to the officer in charge in the form of tracings or the equivalent as regards facility for blueprinting. These will be returned to the contractor, either with blueprints of same stamped "approved," or to be revised as directed. In the latter case the necessary corrections shall be made and the revised drawings submitted before proceeding with the work. Approval of plans will be of a general nature and will not relieve the contractor from errors or omissions that may exist therein. Previous to the acceptance of the work one complete set of tracings, in accordance with the actual work, of all plans required of the contractor, if any, shall be furnished to the Bureau of Yards and Docks.

24. *Checking plans and dimensions, lines and levels.* — The contractor shall check all plans furnished him immediately upon their receipt and promptly notify the officer in charge of any discrepancies discovered therein. Figures marked on plans shall, in general, be followed in preference to scale measurements; but the contractor must compare all plans and verify the figures before laying out the work, and will be held responsible for any errors therein that thereby might have been avoided. Large scale plans shall, in general, govern small scale plans. In all cases where dimensions are governed by conditions already established the contractor must depend entirely upon measurements taken by himself, scale or figured dimensions to the contrary notwithstanding; but no deviation from the specified dimensions will be allowed unless authorized by the officer in charge. The contractor will be held responsible for the lines and levels of his work, and he must combine all materials properly.

25. *Inspection.* — The contractor must afford every facility necessary for the safe and convenient inspection of the work throughout its construction. The officer in charge shall have power to reject material and workmanship which are not in accordance with the contract, and all such must be removed promptly by the contractor and replaced to the satisfaction of the officer in charge without extra expense to the Government. Should it be deemed advisable by the officer in charge to make an examination of work already com-

pleted by removing or tearing out the same, the contractor shall furnish all necessary facilities, labor, and material. If the work is found to be defective in any respect, due to the fault of the contractor, he shall defray all expenses of such examination and of satisfactory reconstruction. If the work be found to meet the requirements of the contract the actual cost will be allowed the contractor. Provisional acceptance in the course of construction shall not preclude rejection upon the discovery of defects previous to acceptance of the completed work. All inspection of material and workmanship will be made, unless otherwise stated herein, after delivery at the site.

26. *Order, protection, and completion of work.* — The contractor shall proceed with the different parts of the work as approved by the officer in charge. He shall protect his material and work from all deterioration and damage during construction, and upon completion shall, without delay, remove his plant and all surplus material and rubbish from the site.

27. *Schedule of prices.* — Before the first payment becomes due the contractor shall submit a detailed schedule of prices for material furnished and for material furnished and worked into place to the officer in charge, who will check and forward same to the Bureau of Yards and Docks with his recommendation, and this schedule will govern the preparation of monthly estimates after it has been approved by the Bureau.

28. *Payments and reservations.* — Monthly payments will be made by the Navy Department upon public bills, based upon monthly estimates and the schedule of prices above described, certified to by the officer in charge and approved by the Bureau of Yards and Docks. Ten per cent of the amount of each monthly estimate will be withheld until the completion of the contract and the acceptance of the work. All reservations thus withheld will then be paid upon public bills certified and approved as above.

29. *Work to be done by the Government.* — The Government will do all earth back filling behind the quay wall and will furnish all pipes, ringbolts, or other devices not elsewhere specified, which the contractor will be required to incorporate in the wall as directed. The contractor will be required to carry on his work without interfering with the ordinary use of the streets or with the operations of other contractors or delaying or hindering any work done by the Government, whether upon the site or not. He shall make good any damage to Government property caused by his operations. It is understood and agreed that the Government and the contractor will, so far as possible, labor to mutual advantage where their several works in the above-mentioned or in unforeseen instances touch upon or interfere with each other. Mutual concessions under the direction of the officer in charge shall be made to secure this end. It is also further understood and agreed that from any such necessary interference, whether resulting in delay or additional expense or not, no claim for extra compensation shall arise, the contract price covering all contingencies of every kind, except for changes provided for in paragraph 17 of this specification.

LOCATION.

30. The quay wall shall be located as shown on the plans, extending from the west end of the existing quay wall in a general southwesterly direction to a point beyond wharf No. 2.

GENERAL DESCRIPTION.

31. The work embraced in this specification consists in furnishing all labor, tools, machinery, and material to build in the best and most workmanlike manner, a quay wall according to the general design and details of construction, as shown on the plans accompanying this specification. This shall include all necessary excavation or dredging; piling driven in place; all cast iron and steel in place; the placing of all concrete and mortar; cleaning, washing, and painting; all shoring, rigging, and false work necessary for the entire completion of the wall.

MATERIALS AND WORKMANSHIP.

32. *Quality.* — All materials and workmanship shall be of the best quality of their respective kinds when the grade is not specifically mentioned, and the acceptance of same is understood and agreed to be subject to the approval of the officer in charge.

EXCAVATION.

33. The site for the wall shall be excavated at least to the depths shown on drawings, leaving a level surface in the undisturbed earth. Any additional excavation necessary to obtain a firm bed shall be filled up with concrete.

PILES.

34. *Piles.* — All piles shall be of first growth Douglas fir, not less than 9 inches in diameter at the small end and 14 inches at the butt, exclusive of bark. They shall be sound, straight, and free from large knots or such defects as might impair their value in this particular foundation. All piles shall be of a length such that they may be driven to refusal by the blow of a 2,000-pound hammer falling freely 15 feet, or to its equivalent. After being cut off at the proper elevation, they must show solid heads, free from cracks or brooming. Piles shall be at least 10 feet long (below cut-off), wherever practicable to drive them this distance without injury to the piles. The plane of cut-off for piles shall in every case be one foot above the bottom of the wall. Pile heads embedded in concrete shall have the bark removed. All piles shall be driven, using suitable iron rings on heads and with ends pointed as required.

METAL.

35. *Steel.* — All embedded steel may be plain, square, or round steel bars of net sectional area equal to that called for on the drawings, and shall be in accordance with the "Manufacturers' Standard Specifications" for "medium steel." A certified statement shall be made to the Bureau of Yards and Docks, by the manufacturer furnishing it, to the effect that the material conforms to the specification requirements.

36. *Location.* — Bars shall be distributed as shown on drawings and carefully secured in place while the concrete is being tamped around them. The rods in the face, top, and bottom of the wall shall be embedded 2 inches from the surface of the concrete.

37. *Splices.* — The splices on longitudinal steel rods shall be at least 2 feet long for $\frac{3}{4}$ -inch rods, and splices in adjacent rods shall not occur in the same

cross-section of the wall. Wherever the section of the wall changes in height, the rods of the two sections shall overlap at least 5 feet. All steel shall be absolutely clean and free from rust, scale, or oil as it is embedded in the concrete and mortar.

PORTLAND CEMENT.

38. *Quality.* — The cement shall be a true Portland cement of an established brand. It must be finely ground and free from lumps, caking, or watermarks.

39. *Kind.* — Slow setting cement will be required.

40. *Packing.* — Cement shall be packed in strong, well-coopered barrels, lined with moisture-proof or heavy manila paper, or in strong cotton-duck bags; each bag to contain one-fourth or one-third of the quantity specified for a barrel. A barrel shall have a gross weight of not less than 400 pounds and the net weight of the cement shall not be less than 375 pounds.

41. *Storage.* — Immediately upon delivery the cement shall be stored by the contractor in a dry, well-covered and ventilated place, thoroughly protected from the weather, as directed by the officer in charge.

42. *Chemical analysis.* — For each lot of 500 barrels, or more, the contractor shall supply a certified chemical analysis from the mill of a mixed sample of the cement taken from any ten barrels. If the cement is supplied in bags, a chemical analysis of an amount equivalent to that specified for barrels shall be furnished. The cement shall not contain more than $1\frac{1}{2}$ per cent of sulphur trioxide (SO_3). The cement shall not contain more than 3 per cent of magnesia. The cement shall not contain an excess of free lime.

43. *Physical qualities.* — The cement shall have a specific gravity of not less than 3.05 nor more than 3.25. The color shall be a uniform bluish gray, free from yellow or brown particles.

44. *Samples for test.* — Samples of the cement shall be taken with a suitable instrument from the interior of the barrels or bags. Samples shall be taken from at least three barrels, and in lots of from twenty to fifty barrels, from every fifth barrel, and in lots of more than fifty barrels from every tenth barrel, or in the same proportion by weight if the cement is supplied in bags. The separate samples for each lot shall be mixed together while dry, and the compound without being sifted shall be regarded as the sample for test.

45. *Fineness.* — Ninety-two per cent by weight shall pass through a No. 100 sieve having 10,000 meshes per square inch, the wires to be No. 40 Stubb's wire gauge, and 75 per cent by weight must pass through a No. 200 sieve having 40,000 meshes per square inch, the wire to be No. 45 Stubb's wire gauge.

46. *Mixing neat cement.* — All neat cement for test shall be mixed rapidly on glass with clean water of a temperature between 60° and 70° F., and in an atmosphere not less than 60° F. The quantity of water used may vary from 16 to 23 per cent of that of the cement by weight, and shall be just sufficient to form a stiff paste.

47. *Setting qualities.* — Five circular cakes of neat cement mixed as specified in paragraph 46, 3 inches in diameter, one-half inch thick in the center, and one-eighth inch at the circumference, shall be molded on glass. They shall be made by rolling the cement paste into balls and flattening to the form specified, care being taken to thoroughly work the cement so as to prevent any cracking at

the edges on account of initial stresses. One cake shall be allowed to set in air and one immersed in sea water. Two wires, A and B, one-twelfth and one twenty-fourth inch in diameter at their lower ends, and loaded with one-fourth pound and 1 pound, respectively, shall be used to determine the setting qualities. Cement shall be considered satisfactory if needle A makes an indentation at the end of forty-five minutes and needle B does not make an indentation at the end of eight hours after having been mixed.

48. *Checking and cracking.* — Three of the cakes prepared as specified in paragraph 47 shall be covered with wet cloths and allowed to set hard. One cake shall be immersed in cold water at the end of twenty-four hours and one kept in moist air above the freezing point. These cakes shall be examined from day to day for a period of twenty-eight days. If either cake warps, cracks at the edge, checks on the surface, or shows brown discoloration, the cement will be rejected. The third cake shall be allowed to set for three days in moist air at a temperature not below 60° F., and then be immersed for six hours in boiling water. If it shows any of the defects specified above, or becomes soft or friable, the cement will be rejected. Fine hairlike cracks on the surface of the cakes specified in this paragraph shall not be cause for rejection.

49. *Sand.* — The sand used for making the mortar briquettes shall be No. 4 standard crushed quartz of such size as to pass through a No. 20 sieve (400 meshes to the square inch), wire to be No. 28 Stubb's wire gauge, and be caught on a No. 30 sieve (900 meshes to the square inch), wire to be No. 31 Stubb's wire gauge.

50. *Making briquettes.* — The briquettes shall be of the shape adopted by the American Society of Civil Engineers as a standard.

Neat briquettes: The cement shall be wet with 16 to 23 per cent of water, by weight (the amount being just sufficient to make a stiff paste when thoroughly mixed), mixing and kneading rapidly by hand, using rubber gloves for protection. When thoroughly worked, the molds shall be filled at once, having first been wiped on the inside with an oily cloth. The cement shall entirely fill the molds and be moderately tamped and worked, so as to exclude all air bubbles, and be immediately smoothed off with a mason's trowel.

Mortar briquettes: One part, by weight, of cement and three parts, by weight, of the sand specified in paragraph 49 shall be thoroughly mixed while dry and then wet with 8 to 12 per cent of water and mixed and molded as specified for neat briquettes.

While drying in air the briquettes shall be covered with damp cloths. After molding the briquettes shall be kept in air for twenty-four hours and then in water, at a temperature of not less than 60° F., and, if possible, not above 70° F.

51. *Tensile strength.* — The briquettes, prepared as specified in paragraph 50, must stand a tensile stress per square inch before breaking, when the load is applied uniformly at the rate of 1,000 pounds per minute, as follows:

Neat briquettes:	Pounds.
After twenty-four hours in air	200
After one day in air and six days in water	450
After one day in air and twenty-seven days in water	650

The seven-day test shall show an increase of at least 50 per cent in strength over the one-day test and the twenty-eight-day test an increase of at least 5 per cent in strength over the seven-day test.

Mortar briquettes:	Pounds.
After one day in air and six days in water.....	150
After one day in air and twenty-seven days in water.....	250

The twenty-eight-day test shall show an increase of at least 20 per cent in strength over the seven-day test.

Five briquettes shall be broken for each test and the average of the three highest considered as the strength of the cement.

SAND.

52. The sand for all concrete and mortar shall be clean, sharp, coarse, and free from clay, loam, or foreign matter. After being shaken in water it shall show not over 5 per cent silt.

BROKEN STONE AND GRAVEL.

53. All broken stone must be granite, gneiss, or trap of acceptable quality. Its largest dimensions shall be not more than 2 inches and its smallest not less than one-fourth inch.

54. Gravel may be used in lieu of broken stone and must be clean sea-washed silica gravel of best quality. It must not be larger than 2 inches in any dimension and none of it shall pass through a screen having 36 meshes per square inch.

CONCRETE.

55. *Proportions.* — All concrete, unless otherwise specified, shall be in the proportion of one part Portland cement, three parts sand, and six parts broken stone or gravel. Except cement, all ingredients of mortar and concrete shall be measured by volume. Cement shall be measured by weight, 100 pounds of dry cement being considered as occupying 1 cubic foot of space.

56. *Mixing.* — Mixing may be either by hand or by a mechanical mixer of a type approved by the officer in charge. If by hand, the cement and sand shall be mixed upon close platforms until of an even color, after which the water shall be added in the form of spray until the mortar is of a proper consistency. The mortar shall then at once be spread uniformly over the proper amount of broken stone, which has previously been wetted. The entire mass shall then be turned over not less than three times, until the mass is thoroughly incorporated, and the ingredients uniformly distributed throughout the mixture. If a mechanical mixer be used, the mixing plant shall be so arranged as to allow of accurately measuring the quantities of the ingredients specified. Should machines be used which do not have proper devices for delivering the required proportions of the ingredients, the proper amounts of cement, sand, and stone required for a batch of not more than 1 yard shall be measured out on the platform and roughly mixed, so that when the dry mass is conveyed to the mixer proper amounts of each of the ingredients will be taken up in each operation. All concrete shall be mixed in the presence of an

inspector, and the contractor shall give due notice to the officer in charge when mixing is to be proceeded with. The officer in charge may reject any concrete mixed when such notice has not been given.

57. *Depositing.* — Before any concrete is deposited, the site shall be cleared from all mud, refuse, or material objectionable to the officer in charge. The contractor will be allowed to deposit concrete under water up to an elevation of 1 foot below mean low water by use of a tremie, or other method satisfactory to the officer in charge. Substantial forms shall be used, so built as to prevent currents of water flowing through them, and care shall be taken to keep the surface of the concrete approximately level. No concrete above an elevation of 1 foot below mean low water shall be deposited under water. Water shall be excluded from the forms until the concrete has been in place three hours. Concrete shall be deposited in homogeneous layers, not exceeding 9 inches in thickness, and shall be dumped as closely as possible to its place, using an inclined chute and a minimum rehandling in the forms. No concrete shall be used which has begun to set, nor shall it be permitted, except in continuous laying, to deposit concrete upon that which has been in place less than twelve hours. Layers shall be stopped against vertical plank forms and properly stepped off. Wheeling or walking over the concrete will not be allowed after it has begun to set. The surface of each layer which has been in place more than twelve hours shall be thoroughly moistened and covered with a layer of cement grout not less than $\frac{1}{8}$ inch thick before depositing the succeeding layer upon it.

58. *Tamping.* — The concrete shall be of such a consistency that when mixed as specified and deposited in place it shall form a quaking mass, and only a small amount of tamping shall be required to cause the water to flush to the surface. As soon as water flushes to the surface tamping shall be stopped. Steel rods shall be entirely incased in concrete securely tamped around them without being displaced from position or alignment.

59. *Finish.* — The front and top of the wall shall be faced with a layer, 2 inches thick, of cement mortar, one to two. This facing shall be deposited in place next to forms at the same time as the body concrete, so as to unite with the backing and form a monolithic mass. On removal of the forms the facing shall show a dense uniform surface free from pits, blowholes, bubbles, or other defects. The application of cement mortar to the face in the form of a plaster or wash will not be permitted.

60. *Nosing.* — The exposed edge of the wall shall be finished with a cast-iron nosing as shown on plans. It shall be made of tough gray foundry iron and shall be true to pattern, free from blowholes or honeycomb. Castings shall be cleaned from sand and fins and then heavily coated by dipping in 300° bath of distilled coal tar varnish containing 5 per cent of pure boiled linseed oil.

61. *Pipes and fittings.* — The contractor shall build in all water and sewer pipes ringbolts or other devices as directed by the officer in charge.

FORMS.

62. All concrete shall be deposited in forms of a substantial character. Frames for holding forms, and the forms themselves, shall be of sufficient size and strength to maintain their proper position while the concrete is deposited

and tamped. If the parts of the framework for holding the forms in position are tied together with wires or tie-rods the ties shall be of an approved design such that no ironwork is left exposed on completion of the wall. Forms shall, in general, be made of sound 2-inch plank surfaced one side and two edges laid up with close joints. Forms for front surface of wall shall be made of 2-inch dressed lumber tongued and grooved.

63. *Removal of forms.* — After the work is completed and the concrete set at least fourteen days the forms may be removed, except those on the face of the wall below mean low water, which shall not be removed for thirty days except by permission of the officer in charge. Planks shall be cleaned before using a second time.

PROPOSALS.

64. *Certified check and bond.* — Each proposal must be accompanied by a certified check, payable to the Chief of the Bureau of Yards and Docks, for the sum of \$1,000, as a guaranty that the bidder will execute the required contract within ten days after its delivery to him for that purpose, and give a bond (preferably that of a first-class surety company) in a penal sum equal to 20 per cent of the contract price, conditioned upon the faithful performance of the contract. This bond is not required with the proposal, but a guaranty bond may accompany the proposal, if preferred by the bidder, in lieu of and of the same amount as the certified check specified above. Checks of unsuccessful bidders will be returned immediately after the contract is awarded, and of the successful bidder upon the execution of the contract.

65. *Form of proposals.* — Proposals and all exhibits, alternate plans, letters of explanation, circulars, and all other papers (except the certified check) which it is desired to have considered in connection therewith must be made in duplicate. Proposals shall be made upon the prescribed blanks furnished bidders, as follows:

Item 1. Price for the quay wall complete in accordance with the plans and specifications.

Item 2. Amount to be added to price named under item 1 if Thacher, Ransome, or corrugated bars are used throughout in place of plain bars.

Item 3. Amount to be added to price named under item 1 for the addition of 50 lineal feet of the 21-foot high section of wall.

Item 4. Amount to be deducted from the price named under item 1 for the omission of 50 lineal feet of the 21-foot high section of wall.

66. *Acceptance and rejection of proposals.* — The Government reserves the right to award the contract upon any of the above items, to accept any bid, to waive any defects and informalities in the proposals, and to reject any or all bids.

67. *Bidder's ability.* — Before he is awarded the contract any bidder may be required to show that he has the necessary facilities, experience, and ability to perform the work in a satisfactory manner.

68. *Examination of site.* — Intending bidders are expected to examine the site of the proposed quay wall and inform themselves thoroughly of the actual conditions and requirements before submitting proposals.

69. *Proprietary articles.* — Where proprietary articles are mentioned herein, bidders may base their proposals upon similar articles of equal value and efficiency, but the fact that they have done so must be stated therein, and in all cases when not so stated such articles may be installed only with the approval of the officer in charge.

70. *Amount of appropriation.* — The appropriation now available is \$51,000.

71. *Information.* — For any further information needed by intending bidders, application should be made to the Chief of the Bureau of Yards and Docks or to the Commandant of Puget Sound Navy Yard. Any discrepancies or omissions noted by the intending bidders in plans or specification should be promptly referred to the Chief of the Bureau of Yards and Docks, Navy Department, Washington, D. C., for correction or interpretation before the letting.

NAVY DEPARTMENT,

Bureau of Yards and Docks, March, 1905.

CHAPTER V.

SPECIAL FORMS OF CONTRACTS.

THIS chapter takes up the matter of contracts in a general way, and more particularly "special" contracts, because no two "special" contracts are alike.

In the first place, in drawing up a special contract the definition of a contract must be borne in mind, namely: "A contract is an agreement to do, or not to do, a particular thing." The essential elements of a contract were taken up in Chapter II; these elements must be adhered to in any contract. Some of these points are the time and place; the parties; the subject-matter, which must be lawful; the agreement must be mutual, that is, the parties must understand the contract in the same way so that there may be no real grounds for disagreement, although the signing of the contract makes the agreement mutual. In ordinary bridge and building work there are, as we have learned, regular contracts with blank spaces that have only to be filled out; but in making special engineering contracts there are so many important minor details to be covered that only very general blanks could be used, so it is best to write out the entire document.

The drawing up of a special engineering contract should never be turned over entirely to an attorney. Lawyers very seldom know more than the most general principles of engineering and cannot always draw up such a contract correctly. In drawing a special engineering contract, it should first be written out in full, and then submitted to an attorney for his consideration of the legal points involved.

In special engineering contracts a great deal of attention must be paid to the minor details, much more so than in an ordinary contract. Some of these points are the names and date; then under "Witnesseth," what the work is to be; the amount and times of payment; the date of completion, etc.

One contract which was drawn up some time ago, covering engineering work, and then later on construction work, was drawn

up in paragraphs for the purpose of clearness. It is very convenient to draw the contract up in numbered paragraphs, for then if it is necessary to refer to anything in a previous paragraph it is possible to mention the number of the paragraph and refer to it more clearly.

In drawing up a contract, the different subjects that go to make up the paragraphs should first be set down, and then each item should be written up.

Another contract recently written was for some heavy construction work. The first paragraph states the work that is to be done and the amount and date of the first payment. Three or four other paragraphs, also, have clauses dealing with the payments. The second paragraph deals with the detailed working plans and the amount of payment for that portion of the work. The third paragraph gives the details of the construction work and the method of payment for it.

Engineers have no regular scale of charges such as architects have for paying for completion of plans; but do not undercharge. People are willing to pay what the work is worth, and they will not have the respect for a man who undercharges for his work that they have for the man who asks what the work is worth. It is a very good plan to try to adhere to the architect's scale of charges, namely: 1.5 per cent for preliminary plans, 2.5 per cent for detailed plans and specifications, and 5 per cent when superintendence is included.

The fourth paragraph of this agreement takes up the construction work, after the detailed plans have been made; also the amount and method of payment. The method of payment is taken up more in detail in the fifth paragraph, which is on monthly estimate, according to the amount of work done.

In railroad or big corporation work, the railroad or corporation engineer makes up the monthly estimates; but in doing work for private parties a detailed list of the work done and the amount due for the preceding month, for each part, should be made and handed in before the tenth of each month, so it can be checked up and verified before payment is due on the fifteenth.

The sixth paragraph specifies the method of financing the work. Whether it is to be done by means of selling stock or bonds, or by whatever means the work is to be financed, it must be taken up in the contract.

The engineer who will make the biggest success of his work is the one who knows most about the general business conditions of the country and who can finance work. In the great Northwest there is a great deal of work under contemplation that needs only capital to make it go through.

The eighth paragraph deals with the time of the completion of the work. After that there is a provision for extension of time on account of delays caused by strikes, slowness of companies from whom machinery is ordered, and various other things. Such a clause as this should always be inserted for the contractor's own protection against unavoidable delays.

The ninth paragraph specifies the time in which the various parts of the work to be done precedent to the construction work shall be completed. The tenth paragraph provides that the company shall furnish surveyors, engineers, and superintendents to look after the work. There should always be a company engineer on the ground to look after the work, and this should always be specified in the contract. The other paragraphs have to do with possible modifications in the plans and the compensation for any extra work that may have to be done.

An understanding of special contracts can be gained only by actual practical experience. No two contracts are just alike, and no two pieces of work require the same treatment.

The insurance business is carried on very largely for the profit that can be gotten out of it in various ways. But contracting companies cannot get along without insurance. An Employer's Liability policy should always be carried, so that if any of the employees are hurt in any way the insurance company will have to defend the suit instead of the contractor having to do it himself. When a man is hurt, an unscrupulous doctor will call in some "shyster" lawyer, and together they will patch up a case; and "work" the company for which the man was working for several thousand dollars and make a big rake-off. This is a very common case of blackmail against contracting companies. But if a case like this is turned over to an insurance company, they put experienced men on the case, and usually get off by paying only two or three hundred dollars. Insurance should also be carried to protect the company against injury to an outsider. Spectators are in great danger of being injured about some kinds

of work, and there are also insurance companies that take care of liabilities incurred in this way.

Some contracting companies are incorporated in one state and work in some other one, and then any damage suit brought against the company is fought out in the United States Court, which cannot be bribed or bulldozed.

Railroads and large firms do not always carry fire insurance when their property is scattered over a great deal of territory, and there is small danger of very serious conflagrations in several places at the same time, and no vital risk, such as there would be in a large plant or factory. But small companies should always insure against fire if they have much combustible property. It would cost a railroad company more to pay premiums on their property than they would get back in a year on fire losses.

Engineers should be posted on deeds, leases, and also corporations. The large jobs of to-day are almost entirely handled by corporations. A corporation is practically an individual, and the liability of stockholders of corporations is limited. If a company is incorporated for \$1,000,000 in Nevada, but the stockholders only subscribe \$100,000 of it, they can be held liable for only the \$100,000.

Synopsis of Nevada Corporation Law.

There is no franchise tax in Nevada, wherein it differs from the laws of New Jersey, Delaware, and West Virginia.

The annual franchise tax on a capitalization of \$1,000,000 in

West Virginia is	\$ 410.00
Delaware is	500.00
New Jersey is	1000.00
Nevada is	Nothing

Under the Constitution and under the Corporation Law in Nevada there is no personal liability for corporate debts.

Annual meetings and business meetings may be held outside of the State, and one or more offices maintained outside of the State, if an office and resident agent is maintained within the State.

The State Agent and Transfer Syndicate (Incorporated) is chartered and authorized to act as such agent.

Corporate purposes are unlimited and may include as many branches of business as the incorporators may set forth in their articles of incorporation.

The right to consolidate incorporations, or to merge their interests, is permitted, the fee being simply on the amount of gross capital above that of the combined corporations.

The capital stock may be made absolutely non-assessable, or may be made assessable up to the par value of the stock, as may be required by the necessities of the corporation.

Nevada corporations can sue or remove causes to the Federal Courts, which privilege is denied corporations formed in Arizona or any other Territory.

By-Laws and Articles may be amended as occasion requires.

The duration of corporations is not limited.

The fees required by the State Agent and Transfer Syndicate, Inc., for maintaining an office and acting as resident agent for transferring, registering, and countersigning certificates of stock, bonds, etc., for acting as trustee, etc., and for receiving and managing any sinking funds, etc., are as follows:

For corporations whose capitalization is

\$1,000,000 or over	\$100 per annum
500,000 or over	50 per annum
All others	25 per annum

This includes all expenses except fees required by County and State laws to wit:

Fees — Secretary of State, 10 cents for each \$1,000 of capital stock; but in no case less than \$10.00. [See Gen. Corp. Law, Sec. 102.]

Fees for County Clerk:

Filing	\$.25
Recording per folio .....	.30
Certificate of copy	1.00

The following form for Articles of Incorporation strictly follows the General Corporation Law of Nevada.

Articles of Incorporation

OF THE

Know All Men by These Presents: That we, the undersigned, have this day voluntarily associated ourselves together for the purpose of forming a corporation, under and by virtue of the GENERAL CORPORATION LAW of the State of Nevada;

AND WE HEREBY CERTIFY: 1st. That the name of said corporation is and shall be

[The name of the corporation must end either with the word "incorporated" or one of the following words, used as a substantive or noun, "Association," "Company," "Corporation," "Club," "Society," or "Syndicate."]

2d. That the place where its principal office is located is on Carson street, at Carson City, County of Ormsby, State of Nevada, and the resident therein and in charge thereof is the State Agent and Transfer Syndicate, Incorporated, but an office may be maintained at No.....street, in the City of....., County of....., State of....., or at such other place or places as may be named by its Board of Directors, or as may be fixed by the by-laws of said corporation.

3d. That the objects and purposes for which this corporation is formed are..... [Here state all the objects of the corporation.]

4th. That the amount of the capital stock of said corporation shall be \$....., divided into.....shares of the par value of.....\$.....each.

[If there be different kinds of stock, the kinds and amounts of each must be stated. See Gen. Corp. Law, Sec. 4, Subdivision 4.]

5th. The name of each of the original subscribers to the capital stock, and the amount subscribed by each, are as follows:

Name.	No. of Shares.	Amount.
.....
.....
.....

6th. That the period of the existence of said corporation shall be unlimited.

7th. That the affairs and business of said corporation shall be managed by a governing board, consisting of (not less than three) members, who shall be styled "Directors."

8th. That the capital stock of the corporation, when fully paid in, shallbe subject to assessment.

[If it be desired that the stock be non-assessable insert the word "not." The Certificate of Articles of Incorporation may also contain any provision which the incorporators may choose to insert for the regulation of the business and for the conduct of the affairs of the corporation, and any provisions creating, defining, limiting, and regulating the powers of the corporation and the rights, powers, and duties of the directors, the stockholders or any classes of the stockholders, or holders of the bonds or other obligation of the corporation, or providing for the governing of the distribution or division of the profits of the said corporation, Provided such provisions are not contrary to the laws of this State.]

The form of acknowledgment required by the Laws of the State of Nevada should be used in all cases and is as follows:

STATE OF }
COUNTY OF } ss.

On thisday ofin the year one thousand nine hundred and....., before me,....., Notary Public in and for said county, personally appeared....., known to me to be the person...described in, whose name.....subscribed to and who executed the within instrument, and who acknowledged to me that...he....executed the same freely and voluntarily, and for the uses and purposes therein mentioned.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my official seal, at my office, in the County of....., the day and year in this certificate first above written.

.....
Notary Public in and for.....County,

CHAPTER VI.

INSPECTION OF ENGINEERING WORK.

THE inspection of engineering work is a field in which many young engineers are engaged, at least temporarily; it is ordinarily a stepping stone to some other position in engineering work.

While the matter of inspection has been mentioned before, and will be mentioned incidentally at other times, it is of enough importance to warrant taking time to discuss it somewhat at length.

The ordinary inspector is one who has for a basis of his knowledge practical experience and very little else, so that, as a rule, inspectors are not highly paid men nor men who have any further interest in their work besides simply earning wages, or getting all the money that there is in it. It would be much better if all of the inspectors on engineering work were educated engineers, so that the different questions arising would be approached understandingly; in fact, it is almost certain that the time will come when engineers and all connected with engineering work will be licensed and regulated by law, as is the case with lawyers and doctors.

Engineers who have just graduated are in some respects peculiarly fitted for performing the duties of an inspector, and on the other hand they are in many respects woefully lacking. Their studies form a splendid basis on which to build up a practical knowledge of the carrying out of work, but in the beginning, of course, they are largely dependent upon making conclusions from observations at the time, and more particularly upon the advice of the engineer in charge of the work, who also has charge of the inspectors. The young engineer should not assume in beginning work of this kind that his college work has taught him enough to warrant his making decisions offhand without careful consideration and careful study.

While it is ordinarily considered that the engineer is the arbitrator as between the contractor and the owners, in reality the inspector comes more nearly filling this position than does the

engineer himself, as upon the integrity of his reports as to the execution and progress of the work depends the opinion which the engineer will form and on which he will act in dealing with the contractor.

As a logical starting out work, it would certainly be very much better for the young engineer to start in contracting work, or at least to engage in it in some capacity or other very early in practice, so as to get the point of view of the contractor firmly fixed in mind and be better able to do justice from the knowledge of both sides of the case.

In a recent article on Specifications it has been stated that an engineer should never write a specification under which he would be unwilling to do work as contractor or to sign up a contract to do the work. Unfortunately, a very large number, one might almost safely say a majority, of specifications are written so that the engineer would himself be afraid to take the contract under it were his own capital hazarded. An inspector looking after work that is being carried out under such specification would be placed in a very delicate position, as it would be possible very often to break up a contractor entirely by insisting on the "pound of flesh" in every case, instead of allowing his best judgment to interpret, or, as Cooper states on the cover of his Specification: "To interpret them upon the broad grounds of professional intelligence and common sense."

A specification should never be written by an engineer where he is so lacking in knowledge of a subject as to have to add a clause stating that in any event the work and material shall be of the very best of their respective kinds, or that the work must finally be done to the satisfaction of the engineer, no matter what has been specified previously.

In illustration of the points already mentioned, it will be as well to take up the inspection of different classes of work and go over the steps in the inspection of the material and workmanship.

The first stage in the inspection of a steel bridge is the checking up of the working drawings, assuming, of course, that the strain sheet has been checked over by the engineer prior to the placing of the contract. These working drawings must be run over in detail to make sure that all dimensions are correct and all sizes of material have been correctly stated, and that all de-

tails and field connections are properly drawn out. It certainly, however, is no part of the inspector's duties, and he would certainly be exceeding his authority, to demand a change in the type of details, provided they agree with the specification and are sufficiently strong; yet I have known of cases where inspectors have required practically all the details on the bridge to be changed after drawings were completed, in order to simply satisfy hobbies of their own.

After these drawings are approved, the bridge company furnishes the inspectors with copies of the orders for material from the mills; each heat or piece as it comes from the rolls is sampled and tests made both of the chemical composition and of the physical properties. Provided these are up to or exceed the specifications, the material should be accepted and shipped to the manufacturing shops.

To follow through material at one of the big rolling mills, where there is a certain size of material rolled each day, often requires weeks or months of diligent attention upon the part of the mill inspector, so that very seldom, except on very large jobs, are special inspectors employed for any particular piece of work, but the work is placed in the hands of a firm, who will have an inspector at the mill in question looking after a large number of orders for material being gotten out for various shops or structures.

This chemical and physical inspection of material is one which is almost entirely in the hands of engineers, and will doubtless remain so on account of the purely scientific nature of the work.

When the material arrives at the bridge shop, it is first carefully straightened by passing the plates through straightening rolls, and the bars and shapes through a straightening machine of some type or other. The inspector must see that this is carefully done, for upon this depends the proper distribution of the stresses in the various portions of a built-up member. Next the wooden templets are clamped on the iron and center punch marks made where each hole is to be punched in the material. The inspector must see that the punches and dies are of the proper size and design, so that ragged and cracked holes will not result. After this, the various separate pieces are bolted together to form built-up members. The inspector must watch to see that they are properly put together, so as not to make a mistake in

right and left hand members, or in some other detail. After the member has been assembled, then any unfair or imperfectly matched holes, where two or more pieces are to be riveted together, must be reamed out so as to leave a true hole for entering a hot rivet. Most first-class shops run a reamer in every hole, so as to true it up, finding that it pays by reducing the cost at the riveting machine. With perfectly true holes, several thousand rivets a day may be driven by a modern riveting machine, and if the holes are true, the rivets properly heated, and the air pressure kept up to 90 or 100 per square inch, there will be little probability of loose rivets. However, after the riveting is all done, each rivet should be tapped with a hammer to find out whether it is loose or not. An inspector can easily go to extremes in this, as in one case that is called to mind, where the inspector abandoned the small hammer and took a large sledge, so as to pound the rivets and loosen them if it was possible in any way. There is no use in being so particular about riveting, as the large factor of safety always used and the uncalculated friction of the rivet heads would prevent any trouble from an occasional rivet that might be pounded loose with a sledge.

After this, the members are planed off in rotary planers, the pin holes bored at the drill presses and then sent out into the yards for painting.

Everything should be carefully inspected by the inspector before painting is done, as the application of paint often covers up a multitude of sins.

When the member has been thoroughly inspected, including careful checking of finished dimensions, it is then ready for loading on the cars to be shipped out to the bridge site.

The work of an inspector on bridge erection is, if any different, somewhat more difficult than the shop inspector's duties. As the bridge is put together, it is necessary to watch carefully to see that everything is properly packed on the pins, and as field riveting and painting progresses, see that this is properly done.

Sometimes a test train is prescribed, and in this case the inspector, or perhaps the engineer and inspector, must take deflection readings with an engineer's level to determine whether or not the bridge has too much deflection under the loading.

The above inspection is of a kind that can be quickly learned by the young engineer, as it is almost wholly scientific or academic.

The inspection of foundations, however, is work which calls for a larger measure of practical experience, and in which judgment should have a larger play than purely theoretical considerations.

The first thing on the foundation is to make a thorough inspection of the site, which can very often be done by the study of the geological formation of the country, supplemented by digging some test pits. But for foundations in a river it will be necessary to make some test borings and get samples of the material through which the drill passes, so as to note exactly the character of the strata on which the foundation will rest, into which it will be sunk, or into which piling will be driven to support the foundation.

It is easier to make a mistake on the character of the bottom to carry foundation than on almost any other class of work, for without considerable experience the drill may tell a false story. On the great Red Rock cantilever bridge, at the Needles, in California, an experienced engineer made the borings and thought he had discovered solid rock at no great depth; but when one of the pneumatic caissons was sunk down to the hard bottom it was found to be nothing but a large bed of boulders, so that the light pneumatic caisson already constructed had to be removed and a heavier one constructed to go down through the boulder bed to proper foundation.

When the pier is to be founded on a pneumatic or dredged caisson, the material entering into its construction must be carefully inspected; good, sound timber, that will come up to at least ordinary specifications, must be used. If any great amount of metal is to be utilized, or a caisson is to be constructed entirely of metal, then the metal must be given the same inspection as has been spoken of for steel bridges. When the foundation is to be started with piling, the piling must be first class, live timber, of proper size, and practically straight. A very large number of specifications written specify the taper on piling; that is, a size for the small and large ends which do not agree at all with the timber to be used; therefore it is impossible in such a case to comply with the requirements. In such a case as this the inspector would certainly either have to override the specifications or take the matter up with his superior to have it modified.



In some specifications on recent work the piling was simply specified as "first class piling"; but when it was delivered and inspected a large amount of it was rejected because it was second growth. It is the writer's opinion that this was a mere technicality, as the samples, by the parties, from first-growth piles and second-growth piles, showed no greater range in density than can be found in several samples of first-growth timber. In fact, the foreman on the work, to test the case, cut one pile in two, and the small end was accepted as first-growth piling, and the large end, which had been carefully marked, was later rejected because it was second growth. Thus it would be well to beware of "straining at gnats and swallowing camels," as almost nine out of every ten inspectors do.

The inspection of cement used in concrete work should be carried out carefully by taking a sample from one barrel in every ten, and have the testing carried out in accordance with the specification under which the work is being constructed, or under such specification as may be agreed upon by the parties, when making the contract, to govern the case. It is not necessary to go into details on this.

The selection of the proper kind of broken stone is one which requires considerable judgment; but the stone should always be some of the hard kinds of trap or granitic rocks, as all of the sandstones and most of the limestones are too soft and friable for such use, although limestone, such as "blue limestone," or any approaching marble in hardness, would make first-class concrete.

The matter of inspecting sand is one which can be easily carried out on the ground by seeing that the sand is reasonably clean and of good-sized sharp grains. A very fine powdery sand does not make a good concrete, although a good, sharp sand with a small proportion of earthy matter or clay would be all right. The writer believes, however, that the safest way is to get as nearly a clean-sharp sand as is possible. The amount of earthy matter in sand can readily be tested by taking say half a glassful in a straight-sided glass, and fill up the glass with water, shake it up thoroughly, and allow it to settle. In this way you can measure very closely in fractions of an inch the percentage of mud or earthy matter which settles out of it.

As regards the method of mixing concrete the writer is satisfied that the modern mechanical mixers give the most

satisfactory results. Hand work should never be used unless a mechanical mixer cannot be obtained. In case of hand mixing, the mixing gang must be carefully trained to properly turn over the ingredients so that they will be thoroughly mixed. A Smith conical mixer gives first-class results, but the new Ransom does really as well and has many points of operation in its favor. It is possible to load it and discharge the concrete without stopping the mixer and a wheelbarrowful can be discharged from it and then the flow shut off without any trouble whatever.

It will doubtless be found upon careful reading of the authorities that almost every one at the present day prefers what is known as wet concrete to that formerly used and known as dry concrete. The dry concrete is only wet enough to tamp in place, whereas the wet concrete is made wet enough to settle to position and become a solid mass of its own weight, without tamping.

The inspection of the stone used in piers must be based almost entirely upon judgment, supplemented to a certain extent by the various tests which are ordinarily prescribed to be made, or which are set forth in the specifications covering any particular piece of work.

If getting up a specification do not specify "first-class stone" when granite is meant. If granite is meant say so. If specifying "granite," do not refer to its natural bed, as this is a clause which would refer only to sedimentary or stratifying rocks.

A recent specification called for the "best selected local stone," and specified that it must be free from rot. As granite does not rot, this was additional proof that granite was not required.

The inspector is referred to the "Inspector's Pocket Book" by Austin T. Byrne. While quite insufficient to be called a treatise, it is about the best thing that is published on the subject. By supplementing it with notebooks of his own the inspector will soon have a large enough amount of data together to give him what he will want to refer to in any particular case for inspection or when drawing up specifications.

Let me close by advising the beginner not to consider it one of the duties of an inspector to find fault and make trouble for the contractor, but to get first-class work, as required by the specifications and as interpreted by common sense.

Standard Specifications for Cement.

AMERICAN SOCIETY FOR TESTING MATERIALS.

GENERAL OBSERVATIONS.

1. These remarks have been prepared with a view of pointing out the pertinent features of the various requirements and the precautions to be observed in the interpretation of the results of the tests.

2. The Committee would suggest that the acceptance or rejection under these specifications be based on tests made by an experienced person having the proper means for making the tests.

SPECIFIC GRAVITY.

3. Specific gravity is useful in detecting adulteration. The results of tests of specific gravity are not necessarily conclusive as an indication of the quality of a cement, but when in combination with the results of other tests may afford valuable indications.

FINENESS.

4. The sieves should be kept thoroughly dry.

TIME OF SETTING.

5. Great care should be exercised to maintain the test pieces under as uniform conditions as possible. A sudden change or wide range of temperature in the room in which the tests are made, a very dry or humid atmosphere, and other irregularities vitally affect the rate of setting.

TENSILE STRENGTH.

6. Each consumer must fix the minimum requirements for tensile strength to suit his own conditions. They shall, however, be within the limits stated.

CONSTANCY OF VOLUME.

7. The tests for constancy of volume are divided into two classes, the first normal, the second accelerated. The latter should be regarded as a precautionary test only, and not infallible. So many conditions enter into the making and interpreting of it that it should be used with extreme care.

8. In making the pats the greatest care should be exercised to avoid initial strains due to molding or to too rapid drying-out during the first twenty-four hours. The pats should be preserved under the most uniform conditions possible, and rapid changes of temperature should be avoided.

9. The failure to meet the requirements of the accelerated tests need not be sufficient cause for rejection. The cement may, however, be held for twenty-eight days, and a retest made at the end of that period, using a new sample. Failure to meet the requirements at this time should be considered sufficient cause for rejection, although in the present state of our knowledge it cannot be said that such failure necessarily indicates unsoundness, nor can the cement be considered entirely satisfactory simply because it passes the tests.

SPECIFICATIONS.

GENERAL CONDITIONS.

10. All cement shall be inspected.
11. Cement may be inspected either at the place of manufacture or on the work.
12. In order to allow ample time for inspecting and testing, the cement should be stored in a suitable weather-tight building having the floor properly blocked or raised from the ground.
13. The cement shall be stored in such a manner as to permit easy access for proper inspection and identification of each shipment.
14. Every facility shall be provided by the Contractor and a period of at least twelve days allowed for the inspection and necessary tests.
15. Cement shall be delivered in suitable packages with the brand and name of manufacturer plainly marked thereon.
16. A bag of cement shall contain 94 pounds of cement net. Each barrel of Portland cement shall contain 4 bags, and each barrel of natural cement shall contain 3 bags of the above net weight.
17. Cement failing to meet the seven-day requirements may be held awaiting the results of the twenty-eight-day tests before rejection.
18. All tests shall be made in accordance with the methods proposed by the Committee on Uniform Tests of Cement of the American Society of Civil Engineers, presented to the Society January 21, 1903, amended January 20, 1904, and January 15, 1908, with all subsequent amendments thereto.
19. The acceptance or rejection shall be based on the following requirements:

NATURAL CEMENT.

20. *Definition.* This term shall be applied to the finely pulverized product resulting from the calcination of an argillaceous limestone at a temperature only sufficient to drive off the carbonic acid gas.

FINENESS.

21. It shall leave by weight a residue of not more than 10 per cent on the No. 100, and 30 per cent on the No. 200 sieve.

TIME OF SETTING.

22. It shall not develop initial set in less than 10 minutes, and shall not develop hard set in less than 30 minutes, or in more than 3 hours.

TENSILE STRENGTH.

23. The minimum requirements for tensile strength for briquettes one inch square in cross section shall be within the following limits, and shall show no retrogression in strength within the periods specified: *

* For example, the minimum requirement for the twenty-four-hour neat cement test should be some specified value within the limits of 50 and 100 pounds, and so on for each period stated.

<i>Age.</i>	<i>Neat Cement.</i>	<i>Strength.</i>
24 hours in moist air		50-100 lbs.
7 days (1 day in moist air, 6 days in water)		100-200 lbs.
28 days (1 day in moist air, 27 days in water)		200-300 lbs.

One Part Cement, Three Parts Standard Sand.

7 days (1 day in moist air, 6 days in water)	25- 75 lbs.
28 days (1 day in moist air, 27 days in water)	75-150 lbs.

NOTE. — If the minimum strength is not specified, the mean of the above values shall be taken as the minimum strength required.

CONSTANCY OF VOLUME.

24. Pats of neat cement about three inches in diameter, one-half inch thick at center, tapering to a thin edge, shall be kept in moist air for a period of twenty-four hours.

(a) A pat is then kept in air at normal temperature.

(b) Another is kept in water maintained as near 70° F. as practicable.

25. These pats are observed at intervals for at least 28 days, and, to satisfactorily pass the tests, should remain firm and hard and show no signs of distortion, checking, cracking, or disintegrating.

PORTLAND CEMENT.

26. *Definition.* This term is applied to the finely pulverized product resulting from the calcination to incipient fusion of an intimate mixture of properly proportioned argillaceous and calcareous materials, and to which no addition greater than 3 per cent has been made subsequent to calcination.

SPECIFIC GRAVITY.

27. The specific gravity of the cement ignited at a low red heat shall not be less than 3.10, and the cement should not show a loss on ignition of more than 4 per cent.

FINENESS.

28. It shall leave by weight a residue of not more than 8 per cent on the No. 100 and not more than 25 per cent on the No. 200 sieve.

TIME OF SETTING.

29. It shall not develop initial set in less than 30 minutes, and must develop hard set in not less than one hour, nor more than ten hours.

TENSILE STRENGTH.

30. The minimum requirements for tensile strength for briquettes one inch square in section shall be within the following limits, and shall show no retrogression in strength within the periods specified:*

* For example, the minimum requirement for the twenty-four-hour neat cement test should be some specified value within the limits of 150 and 200 pounds, and so on for each period stated.

<i>Age.</i>	<i>Neat Cement.</i>	<i>Strength.</i>
24 hours in moist air.....		150-200 lbs.
7 days (1 day in moist air, 6 days in water)		450-550 lbs.
28 days (1 day in moist air, 27 days in water).....		550-650 lbs.

One Part Cement, Three Parts Standard Sand.

7 days (1 day in moist air, 6 days in water).....	150-200 lbs.
28 days (1 day in moist air, 27 days in water).....	200-300 lbs.

NOTE. — If the minimum strength is not specified, the mean of the above values shall be taken as the minimum strength required.

CONSTANCY OF VOLUME.

31. Pats of neat cement about three inches in diameter, one-half inch thick at the center, and tapering to a thin edge, shall be kept in moist air for a period of twenty-four hours.

(a) A pat is then kept in air at normal temperature and observed at intervals for at least 28 days.

(b) Another pat is kept in water maintained as near 70° F. as practicable, and observed at intervals for at least 28 days.

(c) A third pat is exposed in any convenient way in an atmosphere of steam, above boiling water, in a loosely closed vessel for five hours.

32. These pats, to satisfactorily pass the requirements, shall remain firm and hard and show no signs of distortion, checking, cracking, or disintegrating.

SULPHURIC ACID AND MAGNESIA.

33. The cement shall not contain more than 1.75 per cent of anhydrous sulphuric acid (SO_3), nor more than 4 per cent of magnesia (MgO).

THE WESTERN BRIDGE COMPANY, SEATTLE, WASHINGTON.											
TESTING DEPARTMENT.											
REPORT OF TENSILE STRENGTH, ELASTICITY, ELONGATION AND REDUCTION OF AREA OF SPECIMENS TESTED.											
Date of Test.	MARK.	Size of Specimen.	Area in square inches.	Ultimate strength per square inch, in pounds.	Limit of Elasticity per square inch, in pounds.	Elongation in in.	Per cent. Elongation.	Area of reduced portion in square inches.	Per cent. of reduction of area.	Per cent. of Phosphorus.	REMARKS.

TEST SHEET FOR IRON OR STEEL.

Actual size 14 inches wide by 8½ inches high.

CHAPTER VII.

ESTIMATING MATERIALS AND THE COSTS OF ENGINEERING STRUCTURES.

THIS chapter may be considered as a continuation of those on "Contracts and Specifications" and not as a new subject, for the estimating of materials and costs of engineering structures plays a very important part in an engineering contract. The first thing necessary is to have the proper kind of forms or blanks on which to draw up the estimate. A great many engineers who have only a small amount of estimating to do, use double-ruled ledger paper on which to make their estimates, as there are enough rulings for ordinary cases; but in drawing up bridge estimates and estimates of other large structures paper is used on which there are a number of specially ruled columns, in which as many separate classes of material can be carried out as are necessary. There should be separate columns for all the varieties of materials, also for size, weight, length and total length. On bridge estimates a space is also left at the top, on which to draw a sketch of the truss.

Another form of estimate paper is used in drawing up cost estimates. On this also there may be a place to draw a diagram, places to set down the various items of cost of various materials and various forms of the same material, rates and amounts.

The first material we will consider with reference to drawing up estimates on a contract is timber. Unless there is a large amount of one size and length to be ordered, it is impossible to get timber cut in uneven lengths. That is, if some timber 21 feet long is wanted it would be necessary to order 22-foot timber, because the mills would not cut it 21 feet long unless a great deal was needed or enough to cut the logs in the woods to special length. Below are some items showing the way timber should be set down to be estimated:

One form is:

	7	6 × 8 — 22-ft. ties
or preferably,	7 ties	6 × 8 — 22-ft.
	16 stringers	6 × 16 — 16-ft.
	36 stringers	7 × 16 — 16-ft.
	14 ties	6 × 8 — 10-ft.

A person should always have system and method in making up an estimate. The figures in columns should always be put under each other. The names of the materials should not run over into the figures, and everything should be kept neat and orderly, otherwise errors and mistakes are almost sure to follow. In taking off timber from a drawing use a red pencil, and as each separate item is taken off be sure to check it off on the drawing. I have here an estimate which I made for a bridge near Fort Lawton. In it I have started at one end of the bridge, taking each class of timber and running right through the trestle, and then going back and picking up other classes, and finally the odds and ends and the little things which are used only once or twice.

Bridge estimating, in which a great deal of the same kind of material of the same size and shape is used, is comparatively simple, but the estimating of materials and costs of steel frames for buildings is a very different thing. In a steel building there are hardly two or three pieces alike, because of the different loads and stresses they have to bear. The joists, beams, and girders are nearly all different, and each separate piece has to be noted and accounted for in the estimate, both for the materials and the costs. Estimating steel work is very intricate as compared with timber work. On blanks for estimating steel there must be columns for the weight of each different class, for the size, shape, length, total length, and weight per foot.

The price of steel is practically the same for all classes except above 15-inch beams and above 6 by 6 angles. The mills, however, at times, make different prices on different classes of material, but at the present time they are all the same price. To avoid trouble from putting all the different classes together, when prices are different, I have a table which gives the proportions of the different classes of materials in an ordinary bridge, so that an average price could be arrived at without setting

down the different classes of material in the estimate. In a bridge where the end posts weigh 6600 pounds for the main pieces the details can be taken care of by adding 40 per cent of 6600 pounds. It is the same with nearly all the members of a bridge, the details being added in by similar method. In the intermediate posts there are probably 60 per cent details. The weight of the posts themselves plus the weight of the details gives the total weight of the posts. The tables referred to previously give the per cent the details would amount to for each kind of member in an ordinary bridge.

In making up a bridge estimate, recently, when in a hurry, there was allowed 25 per cent for details on the whole bridge, and time was not taken to estimate them more closely. Later on when there was time the estimate was checked over and the details figured up for each member separately, and it was found that there was an error of only a fraction of a per cent, so that in a pin connected bridge it is generally right to count on about 25 per cent for details.

In estimating earth work the problem is much simpler, as tables and formulas are used; but always when large quantities are to be taken out allowance should be made. For instance, if a retaining wall which was one-third buried in the earth had to be put in, allowance would not be made in the estimate for taking out just the actual amount of earth which the wall would replace, but a great deal more. It is usual to allow 50 per cent excess in figuring up a small estimate of that kind.

In dredging, quantities of earth are figured up very much as they are in ordinary excavating work. But in this also considerable excess should be allowed for. In one government job on Puget Sound the excavating was stated as about 50,000 cubic yards; the amount actually paid for was 47,000 cubic yards; while the amount actually taken out was about 80,000 cubic yards. In dredging it is impossible to follow a grade line as in other kinds of excavating work; it is necessary to make the channel somewhat deeper, so as to be sure that the channel dredged is deep enough.

In estimating on concrete work a great deal of care is necessary, always, to allow for any contingencies that may arise. Be sure to make liberal allowance for filling in excavation not really specified but necessary in the job. Also allowance should be

made for extra concrete required to fill in rough places. Rough banks used as forms take a great deal more concrete than plank forms, and excess along this line should be allowed for.

In estimating buildings account must be taken of all the thousand and one different minor items which, while small, have to be put in the estimate. To do this according to an engineer's ideas would be a very lengthy process. But a building contractor has little rules which he follows for figuring up these details, which save him a great deal of work and time. The contractors estimate many things at so much per foot, per square foot, or per square, and save a great deal of time and labor in this way.

An engineer would usually estimate each separate item and have a price for each different kind of material.

ESTIMATING THE COST.

Large contracting firms have daily reports coming in from their contracts showing how much work is done each day and how much material is received or used. These reports are to be tabulated later, and make very useful tables to get costs for reference in bidding on new work. The following shows the form of one of these postal card reports:

DAILY REPORT190.....

Plant	No. Hr.....	Unloading.....	No. Hr.....
Repairs Plant	No. Hr.....	Hauling.....	No. Hr.....
Excavating.....	No. Hr.....	Material Received	
Pile Driving	No. Hr.....	.....
Concrete Forms.....	No. Hr.....	.....
Concrete	No. Hr.....	No. Men Working.....	
Piers Msc	No. Hr.....	No. Teams Working	
False Work	No. Hr.....	.....
Removing Old Work	No. Hr.....	Work Completed.....	
Approach	No. Hr.....	.....
Framing Trusses.....	No. Hr.....	Working on	
Erecting	No. Hr.....	.....
Painting	No. Hr.....	.....	Foreman

Tables are used showing the shop cost of different kinds of work in various shops, and are very useful in estimating costs. Costs of material and shop work are greater now than formerly, and this should be allowed for in making up estimates. At the

present time steel is practically one price, \$1.80 per hundred pounds. Of course there are higher prices for I beams larger than 15 inches, and for angles larger than 6 by 6 inches. The cost of raw steel has been as low as 90 cents per 100 pounds in late years.

Besides this there are various items to be reckoned with in estimating the cost of a piece of work, such as the hauling of the materials from the railroad to the site, the cost of removal of the old structure or material present, painting, putting in foundations, excavating, concrete, and the like. The cost of a steel bridge would be represented by the cost of material, shop cost, freight, lumber for span, haul, erection, and painting.

Making estimates on excavating work is largely a matter of experience. A person has to have a good idea of how many cubic yards of different kinds of earth can be handled by the different kinds of tools or appliances per day. He must know how much it costs to run his apparatus per day, and take into consideration all the minor expenses which arise from time to time. A person should not figure on too large an output per day, for it is very easy to overestimate in this respect. Accidents and delays are very liable to occur, and these lower the output considerably. A set of figures giving the approximate cost of running a steam shovel per day is given below. If the machine is owned by the contractor he must allow something to help pay for the depreciation of the machine, and if it is rented he must allow for the rent.

STEAM SHOVEL. — COST OF OPERATION PER DAY.

Rent (?)	\$10.00
Foreman	6.50
Engineman	5.00
Craneman	3.50
Fireman	2.50
Four pitmen	8.00
Coal	4.00
Oil and waste	2.00
Repairs, etc	4.00
Total	<u>\$45.50</u>

The cost of dredging is in a way quite a mystery. An ordinary dredger costs from \$50,000 to \$100,000, so that only the larger contracting firms have them. The cost of operating

and keeping them up is practically kept secret. However, it all comes down to how much it costs to run one per day, including repairs, renewals, and depreciation, how much it costs to distribute the earth taken out, and upon dividing this total by the output per day we have the cost per unit. With a thousand-foot pipe line—a longer one cannot be used to advantage for gravel—500 to 600 cubic yards of gravel can be dredged per day; 800 to 1200 cubic yards of heavy sand; 1200 to 3000 cubic yards of light sand; and as high as 20,000 cubic yards of mud can be taken out in a day.

COST OF CONCRETE WORK.

From tables it is found that for 1, 3, and 6 concrete the cement will run to 1.04 barrels per cubic yard. Then there is the coarse gravel or broken stone, about 1 yard, and sand about 0.36 cubic yard. These things may be tabulated like this for an ordinary wall:

Cement.....	1.04 barrels at \$2.50 per barrel.
Sand.....	0.40 cubic yard at \$1.00 per cubic yard.
Gravel.....	1.00 cubic yard at \$1.25 per cubic yard.
Labor (average).....	\$1.50 per cubic yard.
Forms (ordinary).....	\$1.00 per cubic yard.

Labor is to be estimated from the labor conditions or rate per day and how many yards can be placed per day. All these items added give the total cost of concrete per cubic yard.

The cost of steel building work may be given in the following items: The steel itself, shop work, freight, hauling, corrugated iron covering when it is used, erection, and other items. Corrugated iron costs about \$1.50 per square for putting on, riveting, and painting. The cost of the ordinary building depends upon the cost of each item of material and the cost of the labor.

The cost of laying cast-iron pipe is summed up from the cost of the lead and the hemp for packing joints, cost of excavation per lineal foot, cost of hauling, of planking up excavation, of laying, cost of superintendence, and cost of pipe itself. These things are given quite fully in Rider's "Little Engineer," a small handbook on hydraulic work.

The cost of foundation work is estimated from the cost of excavating, driving piles, placing concrete footings, and building the masonry. Estimates should always be checked over very care-

fully, both materials and costs, before being used. A person should always go over his figures very carefully, or have some one check them, as it is very easy to make errors in an estimate; when once they are used in bidding and the bid accepted, it is too late to correct the error. An engineer for a large contracting company in the East once made an estimate for a bridge in a hurry. He estimated for only half the bridge, intending to multiply by 2, but he forgot to do this. He did not check his figures; handed his work in, broke the company up in business, was discharged — all because he did not verify his work. If possible, a person would do well to get an adding machine to foot up estimates, in this way being able to get more accurate results where otherwise it would be necessary to go over the figures several times to verify the work.

ATLANTIC CONSTRUCTION COMPANY.

MATERIAL RECEIVED.

Dry Dock,.....

DAILY REPORT

For 24 hours ending 6 P.M. 19 ..

Piling (description)
Lumber
Cement, bbls.
Brick, M.
Sand, cu. yds.
Gravel, cu. yds.
Machinery
Miscellaneous

Signed Supt.

ATLANTIC CONSTRUCTION COMPANY.

SUPERINTENDENCE.

Dry Dock,.....

DAILY REPORT.

For 24 hours ending 6 P.M. 19 ..

No.	Men Employed.	Hours.	Rate.	Amount.	
.....	Superintendent.....	.....	.....	.....	.....
.....	Ass't Superintendent.....	.....	.....	.....	.....
.....	Book-keepers .....	.....	.....	.....	.....
.....	Time-keepers .....	.....	.....	.....	.....
.....	General Foreman .....	.....	.....	.....	.....
.....	Engineers .....	.....	.....	.....	.....
.....	Ass't Engineers.....	.....	.....	.....	.....

Total Labor Expense \$
Miscellaneous Expense \$
..... \$
Total Expense, \$

Remarks :

Signed Supt.

ATLANTIC CONSTRUCTION COMPANY.

TIMBER PLACED IN STRUCTURE.

Dry Dock,

DAILY REPORT

For 24 hours ending 6 P.M. 19 ..

Timber Placed in Structure, feet B. M.

Remarks:

No.	Men Employed.	Hours.	Rate.	Amount.	
.....	Foremen.....	.....	.....	.....	.....
.....	Carpenters .....	.....	.....	.....	.....
.....	“
.....	“
.....	Laborers.....	.....	.....	.....	.....
.....	Raftsmen.....	.....	.....	.....	.....
.....	Derrick Hoists.....	.....	.....	.....	.....

Remarks:

Total Earned

Total Expense

Net

Signed

Supt.

Not to be filled
in by
Superintendent.

\$
\$
\$

ATLANTIC CONSTRUCTION COMPANY.

PUMPING.

Dry Dock,

DAILY REPORT

For 24 hours ending 6 P.M. 19 ..

Coal used, Tons at \$, Cost \$

Supplies, \$

Remarks:

No.	Men Employed.	Hours.	Rate.	Amount.	
.....	Engineers.....	.....	.....	.....	.....
.....	Engineers, Assistant.....	.....	.....	.....	.....
.....	Firemen .....	.....	.....	.....	.....
.....	“

Total Earned

Total Expense

Net

Signed

Supt.

Not to be filled
in by
Superintendent

\$
\$
\$

Remarks:

ATLANTIC CONSTRUCTION COMPANY.

CONCRETE.

Dry Dock,

DAILY REPORT

For 24 hours ending 6 P.M. 19..

Concrete Placed, cubic yards

Remarks :

		Hours.	Rate.	Amount.	
.....	Foremen .....	.....	.....	.....	.....
.....	“
.....	Laborers .....	.....	.....	.....	.....
.....	Train Crews .....	.....	.....	.....	.....
.....	Derrick Crews .....	.....	.....	.....	.....
.....	Men Screening .....	.....	.....	.....	.....
.....	Men Loading .....	.....	.....	.....	.....

Remarks :

Total Earned	} Not to be filled in by Superintendent.	\$
Total Expense		\$
Net		\$
Signed		Supt.

ATLANTIC CONSTRUCTION COMPANY.

BRICKWORK.

Dry Dock,

DAILY REPORT

For 24 hours ending 6 P.M. 19..

Brick Placed, M.

Remarks :

		Hours.	Rate.	Amount.	
.....	Foremen .....	.....	.....	.....	.....
.....	Bricklayers .....	.....	.....	.....	.....
.....	Laborers .....	.....	.....	.....	.....
.....	Holsters .....	.....	.....	.....	.....

Remarks :

Total Earned	} Not to be filled in by Superintendent.	\$
Total Expense		\$
Net		\$
Signed		Supt.

ATLANTIC CONSTRUCTION COMPANY.

TRAINS AND DERRICKS.

Dry Dock,

DAILY REPORT

For 24 hours ending 6 P.M. 19..

Coal Used, Locomotives, Tons at \$ \$

Supplies for Trains, \$

Coal Used, Derricks, Tons at \$ \$

Supplies, Derricks, \$

No.	Men Employed.	Hours.	Rate.	Amount.	
	Trains.				
.....	Engineers				
.....	Firemen				
.....	Brakemen				
	Derricks.				
.....	Engineers				
.....					

Total Expense \$

Remarks:

Signed

Supt.

ATLANTIC CONSTRUCTION COMPANY.

COMMISSARY.

Dry Dock,

DAILY REPORT

For 24 hours ending 6 P.M. 19..

No.	Men Employed.	Hours.	Rate.	Amount.	
	Cooks				
.....	"				
.....	Dishwashers				
.....	Waiters				
.....					

Number of Meals Served, at \$

Number of Lodgings, at \$

Total Earnings, \$

Labor Expense \$

Remarks:

Signed

Supt.

DAILY DREDGE REPORT

Dredge _____ at _____

For 24 Hours ending 7 A.M. _____ 190__

NO.	EMPLOYMENT	HOURS		
_____	Captain	_____	_____	_____
_____	Engineers	_____	_____	_____
_____	Levemen	_____	_____	_____
_____	Mates	_____	_____	_____
_____	Firemen	_____	_____	_____
_____	Oilers	_____	_____	_____
_____	Deck Hands	_____	_____	_____
_____	Watermen	_____	_____	_____
_____	Levemen	_____	_____	_____
_____	Blacksmith and Helper	_____	_____	_____
_____	Carpenter	_____	_____	_____
_____	Cook	_____	_____	_____
_____	Towboatmen	_____	_____	_____
_____	Coal Passers	_____	_____	_____
_____	Oil Tender	_____	_____	_____
_____	Pipe Watchers	_____	_____	_____

Character of Material _____

Length of Pipe Line _____

Height of Discharge _____

Number Landpipes _____

Number Pontoon Pipes _____

Rubber Connections in Use. No. _____

Number of Feet Moved Forward _____

Average Width of Cut _____

Average Depth of Cut _____

Number of Yards Excavated _____

Number of Hours Run _____

Time and Cause Each Delay _____

Signed, _____ Captain

Actual size, $4\frac{1}{2}$ inches wide by $11\frac{1}{2}$ inches high.

WEEKLY DREDGE REPORT

Dredge

At

Week Ending

DAY	DATE	LENGTH PIPE	TONS FUEL	HOURS RUN	YARDAGE			
Sunday								
Monday								
Tuesday								
Wednesday								
Thursday								
Friday								
Saturday								
TOTAL								
AVERAGE								

Remarks

Principal cause lost time

Signed

By

Actual size, 6 inches wide by 9½ inches high.

CHAPTER VIII.

BIDDING ON ENGINEERING WORK.

IN the last chapter the making of bids from the standpoint of making estimates on materials used, labor, cost of erection, and all other cost items, was discussed. After bids are made up they are turned in to some person, official, or corporation taking the bids, and there are various forms in which bids are turned in. In government or county work the form is prescribed by law, and this form must be followed. The form of advertising for bids used by the Engineer Corps of the Army is one of the shortest and does not go into the details of the work, but just states the plain facts. The Navy Department usually goes more into the details of the work, giving a short description of what the work is; also in municipal work and county work this is done. In government work let by the War Department, however, the work is not described in the advertisements. A collection of these advertisements is valuable for reference, as they will offer many valuable suggestions as to the manner of writing out advertisements. In the case of municipal and county work it is usually stated in the advertisement how bids are to be addressed and delivered, and the amount of guaranty bond or certified check that must be given. In advertising for army bids, instructions to bidders are given quite fully in the specifications. In municipal and county work the advertisements and the instructions to bidders are often sent out separately.

In the matter of certified checks to accompany bids on private or corporation work, the parties sending out the advertisements are free to ask for any amount that they see fit. When they advertise publicly, and the bidding is open to all comers, they usually make the amount of the check high enough to shut out bidders of little standing. This is also done sometimes in municipal and county work in order to prevent some bidders from getting the work and to give it to some particular con-

tractor who otherwise would not get it. For instance, in some cases checks of \$25,000 have been asked for when the total price of the work was only about \$100,000. This is excessive, and there are not always many bidders who would care to put up such a check as a guaranty to take the contract if the work was awarded them. In the state of Washington 5 per cent of the total cost of the work is the limit put upon the size of a certified check or bidding bond. On the Mt. Rainier War Department road contract a sum of \$500 was required, not in the shape of a certified check but as a guaranty bond. A certified check could probably be given and comply with the law.

When an advertisement has been gone over very carefully, so that one knows just exactly what he is bidding on, the bids are made out in compliance with the advertisement. In Government Army work the form of the proposal is similar to that shown in the Olympia dredging specifications and the Mt. Rainier road work, and the War Department form is generally modeled on the same plan, no matter what the class of work. The proposal always starts out in a formal way, followed by the figures for the various items of the bid, a formal closing paragraph, and the legal signature of the bidder. If the blanks are not properly filled out, the official to whom the bid is being made may throw out the bid if he cares to do so. For county work the form of proposal is not generally specified, but the form is usually the same for bridge work all over the United States, and a copy of such a form is attached hereto. In most blank proposals there is a clause about strikes, accidents, and other delays beyond the control of the bidder. If this clause is not already in the blank contract, it should be put in before signing a contract, since a person or corporation cannot be held in the law for what is not down in writing in the contract, although it was in the proposal, unless the proposal is referred to in the contract and made a part thereof. On a contract with some parties who started their work and later wanted to abandon it without recompensing the contractor, it was agreed to stop work if they would trade another contract they had to let and pay a certain sum for the profit on the unfinished work. They thought there was a clause in the contract stating that they had a right to quit at any time they pleased without settling for profits, and they threatened to take the matter to court. But on examining their copy

of the contract they found that there was no such clause and that they were in the wrong. They then said that they had not read their contract before signing it. Even if they had not, that would have been no legal excuse. A contract should never be signed until it has been read and studied carefully and thoroughly understood.

The general forms of proposals can be found from the various forms attached to the specifications. The blank forms used by the city of Seattle are very different from those in use in the other cases we have discussed, also different from those used by most corporations or private firms. They all have spaces in which to write out in words, as well as in figures, the amounts bid for various things or parts of the work. This is very essential, and should be done in all proposals or contracts whether there is a special place for it or not. Bidders often neglect to do this, and it sometimes leads to serious errors. In bidding on some cement paving work in this city recently a certain contractor made a mistake in the column in which he put down the figures and bid 70 cents instead of \$70. He did not write out the amount in words. The proposal was signed in that shape, so he had to take the contract and lose about \$500 by his error. If he had refused to go ahead with the work, he would have forfeited his guaranty check for \$180, and would not have been allowed to bid on city work again for two years; so he decided to go ahead and stand the loss. Amounts of money should always be written out in words as well as put down in figures. For small contracts, where no special forms for proposal are specified, something similar to the following may usually be used.

PROPOSAL.

To.....19..

GENTLEMEN: We hereby propose to furnish all the material and do all the work necessary to construct, erect, and complete ready for the for in accordance with the plans and specifications for the following price, viz.:

And we hereby propose, if the above proposal is accepted, to enter into contract to faithfully perform the work above mentioned. All agreements subject to strikes, floods, or any other cause beyond our control.

Yours faithfully,

NATIONAL CONTRACT CO.

Agent.

The matter of putting in bids and winning out is largely one of experience and knack. A man has to have a natural idea about these things to make sure of getting a reasonable amount of work to do in this age of competition. Never make a bid in round numbers, but always make it an uneven amount. For instance: If some excavation work came to 45 cents per cubic yard, it would be natural that some one else might arrive at the same figures and put it down to 44 cents a yard, just to get below 45 cents. The other fellow will probably think about it in just the same way, and as he will likely cut his figures to 44 cents or even lower, it would be wise to cut to say $43\frac{8}{10}\%$ cents a yard, provided of course that there is still a profit. I know of a several hundred thousand dollar contract which was lost by one bidder because another bidder cut his price from $15\frac{1}{2}$ cents to $15\frac{4}{10}\%$ cents. Do not bid in round figures, but always make it just a little below and in uneven figures.

Quite often advertisements for bids will have restrictions in them as to who the bidder may be. This is generally a limit with reference to the amount of experience required. In a great many cases if work was let out to inexperienced firms, very poor work would be done, and so there is very often a clause in the advertisement stating the number of years' experience required of a bidder in a particular kind of work. Exclusion clauses are often put in to shut out certain bidders and contractors who have not completed contracts on time for pieces of work for the same advertiser. Also if it is known that in any way a man has played crooked with his former employer, an exclusion clause will often be put in, so worded as to exclude him from the right to bid. In case of failure to accept work for which they are low bidders, contractors on Seattle city work are not allowed to bid again for two years.

In comparing unit bids it is absolutely necessary to have some standard quantities stated as the basis on which to compare them. The quantities to be used as a basis of comparison are usually stated more or less completely in the advertisement or specifications. For justice in deciding between various bids on a unit basis and comparing them, one should insist before bidding that the quantities of various kinds of materials should be given. Then one can be sure when one bidder really is below another. Sometimes one bidder will be very low on some items and expect to make it up on some item where his bid is high, when he knows a larger quantity will be used than has been stated. Account should be taken of all these things, and if a bidder goes very low on one special thing one should examine the bids very carefully to see if he does not expect to make it up on some other items.

Sometimes government officers will ask for alternate bids in order that they may know the cost of doing the work in various ways. Very often a bid will be counted as irregular and not considered at all if the proposal is not filled out in just the specified manner. In bidding on a very heavy sea wall to be erected at the navy yard, I once handed in a bid for a concrete-steel wall as well as for the ordinary concrete retaining wall. Although this was not awarded on the concrete-steel wall, the idea was adopted at another time and that form of construction used.

In the matter of rejecting bids on work, the advertisement or

specifications usually provide that parties receiving bids are at liberty to reject any or all bids if they care to do so. This proviso is put in for the reason that all the bids may be too high, and even if some of them are low enough the parties may not care to accept the lowest bids on account of the standing of the bidder, his resources, plant, or some other good reason. A low bid may be rejected on account of the irresponsibility or the inability of the low bidder to do the work, and a higher bid may be accepted. In this state the law specifies that the lowest and best bid is to be accepted; but it would usually be rather hard to show any reason why the lowest bid would not be the best.

In the case of bidding on private work, the advertisements and proposals usually state at what hour the bids will be accepted and before that hour only. There is a great chance for unfair dealing in doing business in this way, for the bids may all be in and the hour past and some friend of the man running the affair come along and want to hand in a bid, and even though it is too late according to the advertisements, the bid will be accepted. There is no law to govern this case, and private individuals, companies, and corporations can do as they please. I have not touched all the phases of this subject, because much of it does not come under the engineer's supervision.

FORMS FOR ADVERTISEMENTS.

Advertisement for Government Contract.

DEPARTMENT OF THE INTERIOR, United States Reclamation Service, Washington, D.C., May 23, 1908. Sealed proposals will be received at the office of the United States Reclamation Service at Orland, California, until 2 o'clock P.M., August 27, 1908, for the construction of East Park Dam, Spillway and Dikes, located about 12 miles northwest from Sites, Colusa County, California, and involving the placing of about 13,500 cubic yards of concrete and the excavation of about 8500 cubic yards of material. For further particulars address the United States Reclamation Service, Washington, D. C., 307 Tilford Building, Portland, Oregon, or Orland, California. JAMES RUDOLPH GARFIELD, Secretary.

*Advertisement for State Canal.***NOTICE TO CONTRACTORS.**

STATE OF NEW YORK,

OFFICE OF SUPERINTENDENT OF PUBLIC WORKS.

ALBANY, July 14, 1908.

Sealed proposals will be received by the undersigned at his office in the Capitol in Albany, N.Y., until twelve o'clock noon of Tuesday, August 11, 1908, at which place and hour they will be publicly opened and read, for improving the New York State Canals, pursuant to the provisions of Chapter 147 of the Laws of 1903, and of the amendments thereto, as follows:

CONTRACT NO. 31.**ERIE CANAL.****SECTION 4.**

For improving the Erie Canal at Little Falls, and modifying Dam and constructing Guard Gates at Rocky Rift. Length, 1.01 miles. Sheets 1 to 74, inclusive.

Plans may be seen and detailed specifications, engineer's estimate of quantities, proposal blanks, form of contract and bonds required and other information for proposers may be had at the office of the Superintendent of Public Works at Albany, N.Y.; at the office of the Assistant Superintendent of Public Works for the Middle Division at Syracuse, N.Y.; at the office of the Assistant Superintendent of Public Works for the Western Division at Rochester, N.Y.; and at the canal office, Spaulding's Exchange, Buffalo, N.Y.; Copies of detailed plans or drawings may be obtained from the State Engineer and Surveyor at Albany, N.Y., upon payment of the cost of producing them.

Monthly estimates will be paid of ninety per centum (90 per cent) of the work done at the contract price. Every proposal for said work must be accompanied by a money deposit in the form of a draft or certified check upon some good banking institution in the city of Albany or New York, issued by a national or State bank in good credit within the State and payable at sight to the Superintendent of Public Works for five per centum (5 per cent) of the amount of the proposal.

The person whose proposal shall be accepted will be required to execute a contract and furnish bonds within ten days from the date of notice of award delivered to him or them in person or mailed to the address given in the proposal. Upon execution of the contract and approval of bonds, the deposit will be returned to the proposer. The deposits of bidders other than the one to whom the award of contract shall be made will be returned immediately after the award has been made. The amount of bond required for faithful performance will be twenty-five per centum (25 per cent) of the amount of the estimated cost of the work according to the contract price, and an additional bond, known as the labor bond, in the sum of ten per centum (10 per cent) of

the amount of the estimated cost of the work according to the contract price, will be required as security that the contractor will pay in full at least once in each month all laborers employed by him upon the work specified to be done in the contract.

Each proposal must be addressed to the Superintendent of Public Works, Albany, N. Y., and must be endorsed on the envelope with the name of the construction for which the proposal is made.

Award, if made, will be made to the person or persons whose proposal shall be lowest in cost to the State for doing the work, and which shall comply with all provisions required to render it formal. Before any award shall be made the lowest bidder will be required to satisfy the Superintendent of Public Works of his ability to provide suitable equipment and materials for the proper performance of the work.

The right is reserved to reject all proposals and readvertise and award the contract in the regular manner if, in the judgment of the undersigned, the interests of the State will be enhanced thereby.

F. C. STEVENS,
Superintendent of Public Works.

Advertisement for Dredging Contract.

COMMONWEALTH OF MASSACHUSETTS. — Board of Harbor and Land Commissioners, State House, Boston, July 31, 1908. — Sealed bids or proposals for dredging a channel in Plymouth harbor from the Cow Yard to the wharf of the Plymouth Cordage Company will be received by the Board of Harbor and Land Commissioners at Room 131, State House, Boston, Mass., until 2 o'clock P. M., Friday, September 4, 1908, and then and there will be publicly opened and read. The work to be done is the dredging of about 700,000 cubic yards of material to form a channel about 1,100 feet long, 250 feet wide and 20 feet deep at mean low water through the bar near the Cow Yard, and a channel about 5,000 feet long, 150 feet wide and 18 feet deep at mean low water, from the deep water inside the bar to the wharf of the Plymouth Cordage Company, the excavated material to be dumped at sea about 2 miles east of Gurnet Lights. All proposals must be made upon blank forms, which, together with information in regard to the work, may be obtained at the office of the Board, where plans and specifications may be seen. Each bidder will be required to give to the Board satisfactory assurance of his competency, experience and responsibility. The right is reserved to reject any and all bids, and to waive any defect or informality at the discretion of the Board. GEORGE E. SMITH, SAMUEL M. MANSFIELD, HEMAN A. HARDING, *Harbor and Land Commissioners*; FRANK W. HODGDON, *Chief Engineer*.

Advertisement for City Paving.
STREET IMPROVEMENTS.

WHITE PLAINS, N. Y.

Sealed proposals, addressed to the Village Clerk, will be received by the Board of Trustees of the Village of White Plains, New York, until 8 P. M. of the 17th day of August, 1908, for paving improvements, approximate quantities of which here follow:

7,000 square yards of brick pavement.

8,000 square yards of macadam pavement.

4,000 lineal feet of vitrified tile drains and appurtenances.

18,000 lineal feet of bluestone curbing.

18,000 lineal feet of bluestone sidewalk.

23,000 lineal feet of brick gutter.

Plans and profiles may be examined, and upon the payment of one dollar (\$1.00) for each set, which deposit will be returned when proposals are received by the Board of Trustees, specifications and form of agreement may be secured at the office of James F. Goerke, Village Engineer, Room 714, Realty Building, White Plains, N. Y.

Bids must be made in strict accordance with the Instructions to Bidders attached to the Specifications.

By order of the Board of Trustees.

Dated White Plains, N. Y., July 20, 1908.

CHRISTOPHER HARMON,
President pro tem and Acting President.

PETER PAULDING,
Village Clerk.

Advertisement for City Sewers.
SEWER.

OFFICE OF THE COMMISSIONERS OF SEWERAGE
OF LOUISVILLE, INCORPORATED.

Sealed proposals for the construction of a sewer known as Section "D" of the Southern Outfall Sewer, Contract No. 11 of the Comprehensive System of Sewerage for the City of Louisville, Ky., will be received at the office of the Commissioners of Sewerage until 12 o'clock noon August 21st, 1908.

The work consists mainly of building a sewer to be constructed of reinforced concrete as follows: 770 ft. concrete 13 ft. 9 in. in diameter; 2,763 ft. concrete 13 ft. 6 in. in diameter; 1,037 ft. concrete 13 ft. 3 in. in diameter; 1,360 ft. concrete 13 ft. in diameter.

The principal items in the Engineer's estimate of the work are approximately as follows:

Depth of cut, 26 to 42 feet.

Concrete masonry, 11,000 cu. yds.

Reinforcing steel, 660,000 lbs.

Plans and specifications may be seen at the office of the Commissioners and at the office of the Consulting Engineer, Harrison P. Eddy, of Metcalf & Eddy, 14 Beacon Street, Boston, Mass.

Sealed bids should be endorsed "Proposals for Section 'D' of the Southern Outfall Sewer," and addressed to the Commissioners of Sewerage, Equitable Building, Louisville, Ky. Each bid shall be accompanied by a certified check for at least seven per cent (7%) of the total amount of the bid or a "Bidder's Bond" as described in the form of proposal.

P. L. ATHERTON,
Chairman.

CHAS. P. WEAVER,
Secretary and Treasurer.

J. B. F. BREED,
Chief Engineer.

Advertisement for Steel Bridge Contract.

BRIDGE.

NOTICE TO CONTRACTORS.

SALISBURY, MARYLAND.

Sealed proposals, accompanied by plans, addressed to the County Commissioners of Wicomico County, for the construction of a steel plate girder draw-bridge over the Wicomico River, at the crossing of Main Street, Salisbury, Maryland, will be received until 12 o'clock, noon, of the eighteenth day of August, 1908, according to the specifications on file with the Clerk to the County Commissioners, at their office in Salisbury, Md. Each bid must be accompanied by a certified check for \$200, which will become the property of the County, should the successful bidder fail to execute a contract awarded to him. The County Commissioners reserve the right to reject any and all bids.

By order of the Board,

H. M. CLARK,
Roads Engineer.

Advertisement for Stone Bridge Contract.

BRIDGE.

WOONSOCKET, R. I.

Sealed proposals, endorsed "Proposals for Building a Stone Arch or a Concrete and Steel Arch Bridge on Sayles Street and over the Blackstone River," will be received by Stephen Magown, Chairman of Committee on Streets and Bridges, until four (4) P. M. Friday, August 21, 1908.

Each bid must be accompanied by a certified check for the sum of Five Hundred (500) Dollars, made payable to the order of the City Treasurer of the City of Woonsocket, as surety that if the bid is accepted a contract will be entered into.

Plans, specifications and form of proposal and contract may be obtained at the office of the City Engineer.

Contractors may submit design and specification for a steel and concrete bridge.

The right to reject any or all bids is expressly reserved, as the interest of the city may appear.

STEPHEN MAGOWN, Chairman.
JAMES MULLEN,
RAPHAEL P. DAIGNAULT,
Committee on Streets and Bridges.

FRANK H. MILLS,
City Engineer.

CHAPTER IX.

ORGANIZATION OF CONTRACT WORK.

THERE are so many different classes of contracts that it is difficult in any short space fully to outline the methods of organization which would be applicable only in a general way to any particular class of work. The size of contracts also has very much to do with the extent of the organization for handling it, small contracts, of course, not warranting anything like the outlay for management and supervision that could be made for large pieces of work or by a concern handling a large amount of work of different kinds.

There are, moreover, so many classes of contractors, both as to class of work and as to the amount of capital invested, that what would do in one case would be entirely inadequate in another. Many contractors simply take what work they can look after themselves without employing any help whatever, and such ones usually, as the saying goes, "have their offices in their hats." An individual contractor handling a medium amount of work, or a small concern, will, of course, have a small organization to assist in carrying out contracts, while a large contractor or firm will have a very complete organization to handle all contracts and all details in the most complete manner possible.

OFFICE ORGANIZATION is the first thing that would naturally be arranged for by any one entering upon a large contract or engaging in a general contract business. The departments of such an office force would be the general officers, the contracting department, the engineering department, the accounting department, the purchasing department, and the superintending department of the contracts, which latter may generally be included among the general officers.

THE GENERAL OFFICERS of the company are usually a president, vice-president, general manager, manager, chief engineer, superintendent, secretary, treasurer, auditor, and purchasing agent.

In a large concern one person would hold only one of the above offices, but as the concern becomes smaller one person would likely hold two or more offices; for example, the president or vice-president might also hold the office of general manager, or one of them might hold the office of chief engineer, or secretary, or treasurer. The general manager might be termed a general superintendent or might be the only superintendent employed by the concern. The offices of secretary and auditor are very often combined, as are also the offices of secretary and treasurer.

THE ENGINEERING DEPARTMENT has as its head the engineer or chief engineer of the concern, who looks after all engineering matters, including the making of detailed plans on work where only general plans have been furnished, or the making of general plans where the contractor makes the general plan to be submitted with a bid. The engineering department also assists the other departments by making up orders for material to conform to the plans and specifications for the contracts that are to be executed, by making up and checking estimates for work that is to be bid upon and for work that is being carried out. The chief engineer will have as many assistants as are necessary for the amount of work to be carried on, consisting of engineers, estimators, draftsmen, and clerks.

THE CONTRACTING DEPARTMENT is usually combined with or closely related to the engineering department, the engineering work being done under the chief engineer's direction. The bidding on work is generally done under the supervision of the president, vice-president, general manager, or chief engineer, the contracting agents having their figures supplied to them in whatever detail is necessary for properly making up a bid on each particular piece of work. These contracting agents are usually men familiar enough with contract work to make up small estimates or intelligently to modify estimates or to make up, should the occasion arise, figures of proposed changes for making a modified bid. Many contracting firms employ engineers as contracting agents, so that each one is able to make up his own estimates of materials and costs.

THE PURCHASING DEPARTMENT is also very closely related to the engineering department, getting all the data for buying material from the chief engineer or his assistants. It is necessary for the head of this department to be well posted as to all classes

of materials, and both as to actual and relative prices, as very much of the profit of the concern depends upon the skill and care with which the buying is done, the same as in any other line of business. Should the purchasing agent be so careless or inexperienced as to let a firm get the idea that they are the only ones bidding on materials, he will pretty surely not get satisfactory figures, or figures which will be low enough to materially help out the profits. In fact, in no other department is there more need of a high-class man.

THE AUDITING OR ACCOUNTING department is usually under the direct charge of either the auditor or secretary of the company, and all accounts, both general and for each particular contract, are carefully kept by the employees of this department. The general accounts would cover the general expenses, salaries, interest, discount, taxes, office expense, and any other items not directly chargeable to other general or detailed accounts. Contracting expense covers all expenses incurred in the advertising of the business, making up of estimates for bidding, and the actual expenses incurred in the contracting department in salaries, traveling expenses, and the like. Other general accounts which may be mentioned are interest and discount, repairs and renewals, and any other classes of expense which cannot be directly charged to the separate contracts. Separate contract accounts should be kept for each particular piece of work with separate columns, so that each portion of the expense may be segregated in the ledger, such as material, labor, transportation, and after all other items that are desired have been provided for, a column for incidentals, which will cover all small items not properly taken care of under one of the general headings. For example, on steam-shovel work, the separate columns of a ledger account of a contract would be labor, fuel, repairs, supplies, oil and waste, and water. It is advisable, of course, to simplify the bookkeeping as much as possible, in order to have time for properly figuring up and tabulating the cost of work as completed and in order to have data for figuring on new contracts. It has been the writer's custom for many years to use a bookkeeping system wherein the day-book, journal and cash-book are all combined in one, called the synoptic, the general accounts being kept in separate columns of the synoptic, as may be seen from the sample pages, and not posted to the ledger, such items

as are necessary to post up on ledger accounts being carried out into the columns headed ledger, and from which the ledger posting is done. An examination of the sample pages of a contractor's ledger also show how contracts may be satisfactorily segregated. The auditing department also makes up all pay rolls and checks and all statements that are necessary as to the financial end of the business.

THE SUPERINTENDING of the work is generally in charge of the general manager, general superintendent, or superintendent, as the case may be. In case there are a great many branches of work carried on there will be the general superintendent, with as many assistant superintendents as may be necessary to the organization. Under the superintendent are all of the foremen, timekeepers, and employees of the field organization, which will be taken up more in detail later on.

THE STOREHOUSE, which is the general term for tool house, and yard where material and large plant are stored, may be under the manager, superintendent, or directly under the purchasing agent or such other officer as may perform the duties of purchasing agent. This department is usually in charge of a storekeeper who has such clerks and laborers as may be necessary, and in the case of there being material and storage yards for plant there may be a yardmaster or foreman and such assistants as may be necessary. The storehouse should be carefully arranged so that the tools can be readily gotten at and readily repaired and kept in good condition, it even being advisable to have a blacksmith, machinist, and carpenter with their helpers to keep up repairs when a plant is busy. All pieces of plant upon being returned to the storehouse should be put in good repair ready to go out on another piece of work without delay, as special plant is usually sent out in response to a telegram from the superintendent or foreman in the field to help in emergencies. Such stock as is carried in the storehouse or yards should be carefully arranged and carefully sorted out so that it can be readily shipped and so that material will not be purchased which is already in stock.

THE TRANSPORTATION DEPARTMENT of a large contract corporation or organization is also a very important one and may be in charge of either the purchasing agent, transportation superintendent, or shipping clerk. In either case the man in charge

should be well informed as to the different classes and makes of tools and as to the requirements of tools for doing various kinds of work, so that the most suitable outfit, an outfit in proper shape to do work, will always be sent out to the various contracts, as otherwise great inconvenience and even loss result. In a large city it is necessary to have teams for doing the hauling to city work, and at the different depots and docks from which plant and material are to be shipped. The superintendent of this part of the transportation department may also be in general charge of such teams as are used on the various contracts direct.

Where contract work is being carried on in such a region as New York Harbor, San Francisco Bay, or Puget Sound, tugboats, launches, and lighters are quite necessary for the economical and proper handling of contracts, and the superintendent of the transportation department should have an assistant in charge of the floating plant or equipment, who thoroughly understands tugboat operation and the operation and care of lighters or scows and floating pile drivers.

THE FIELD ORGANIZATION may be under the direct charge of the general manager or chief engineer, with a superintendent or superintendents in direct charge of the construction work, as may be necessary to provide for the different classes of work handled, such as municipal work, bridge work, and dredge work, which are distinct and separate kinds of construction. Each separate contract will be in charge of an assistant superintendent for a large piece of work or a foreman for a medium sized or small contract. Where the contract is a large one, under either an assistant superintendent or a foreman, there will be one or more subforemen or as they are usually called, "straw bosses," in charge of the various branches of the work. On work of any size a timekeeper will be necessary for keeping the time of the men, making out time checks, checking off material, and doing such other clerical work as may be necessary. It is necessary to have a man in direct charge of each contract, whether as assistant superintendent or foreman, who is capable of handling men and getting the maximum amount of work out of them and keeping everything in the way of help and plant up to its greatest efficiency and at the lowest possible cost. A poor foreman will easily drop the estimated profit on a job by reason of keeping

inefficient men, paying a higher rate of wages than is necessary, or failing to keep his plant up in first-class shape. He must also see that the work is laid out far enough ahead so that men and material can be kept on the ground to insure the work moving along without any hitch and without expensive delays.

BRIDGE SHOP ORGANIZATION, while a distinct branch of contracting, is more properly a branch of manufacturing, the bridge company having its general officers similar to those before enumerated. The shop itself will have a superintendent thoroughly posted on every branch of the work and preferably an educated engineer who can reason and figure out everything for himself. He will have an office force consisting of stenographers, material clerks, and timekeepers to assist in thoroughly organizing and superintending the plant. The work in the shops will be in charge of foremen reporting to the superintendent, consisting of a yard foreman, who looks after the receiving and storing of material and the shipping out of the finished product, a foreman of the templet shop, where all of the templets or wooden patterns are made for laying out the work and marking holes to be punched for riveting up the material. And there will also be a pattern department under this foreman for making patterns for castings that may be used either in the plant or for the making of iron or steel castings for contract work. In addition to this there will be a foreman of the straightening sheds, laying-out department, punching department, riveting department, boring department and planing department, the machine shop and the forge shop. If a foundry is operated, there will also be a foreman in charge of this. Where plants are operated both day and night, it will be necessary to have an assistant superintendent and a duplicate of all of the shop organization, or so much of it as is operating double turn.

While the foregoing is simply an outline of the organization that it is advisable to have for various kinds of work, do not overlook the fact that it must be modified to suit conditions and to "make the punishment fit the crime." Whatever you do when you are put in charge of work, do not make the very common mistake of making your organization top-heavy, as it is impossible or impracticable to have sufficient help to make contract work easy for those engaged in it without making it top-heavy and making the general expenses of the concern run beyond

what is economical or possible from the standpoint of cost. After twenty years in this kind of work, the writer has found it impossible to get along without putting in long hours and, as the saying is, "working practically day and night and Sunday" to keep things moving along without waste or excessive cost. In this, as in most other things which are made a success, genius simply consists of hard work, and there is no "royal road" to making the wheels turn around continuously and smoothly.

[illegible]

ORDINARY CONTRACT LEDGER.

Actual size, 14 inches wide by 11 inches high.

[illegible]

CHAPTER X.

ESSENTIALS OF CONTRACT LAW.

THE various definitions of a contract have been given in Chapter II, but in this chapter will be given a synopsis of the law of contracts, so as to cover the entire subject in an abbreviated form.

THE ESSENTIALS OF A CONTRACT are given in "Clark on Contracts" as follows:

"As there must be an agreement directly contemplating and resulting in an obligation, and the agreement must be enforceable in the law, therefore,

"(a) There must be a distinct communication by the parties to one another of their intention, or an offer and acceptance.

"(b) The agreement must possess the marks which the law requires in order that it may affect the legal relations of the parties, and be an act in the law. Therefore (1) it must be in the form required by law. (2) There must be a consideration, when required by law.

"(c) The parties must be capable in law of making a valid contract.

"(d) The consent expressed in offer and acceptance must be genuine.

"(e) The objects which the contract proposes to effect must be legal."

AN OFFER AND ACCEPTANCE is the usual method preliminary to the making of a contract. In other words, one party must make an offer and the other party accept the same exactly as the offer was made, in order for the written offer and acceptance to constitute a contract in themselves or form the basis for a formal written contract.

In case the offer and acceptance are verbal, it is necessary to put the contract in writing and have it signed by both parties

NOTE:— This chapter is derived from "Clark On Contracts," and the arrangement of this admirable work has been closely followed. Exact quotations have been made in some instances and throughout the construction has been preserved as nearly as possible consistent with the brevity required.

in order to make the transaction a legally safe one, as it might be difficult to prove the verbal contract.

The offer may be either in writing or verbally, or by means of an act, such as where one party goes ahead and performs work for another under conditions where, without any objection on the part of the person having the work done, it is reasonable to suppose he will pay for the services. In other words, the doing of the work is an offer and the silent consent of the other party may be a legal acceptance.

When an offer is made without limitation as to time of acceptance, it may be accepted by the party to whom it is made in any reasonable time. But if the acceptance contains provisos or modifies the terms of the offer, then the party making the offer is not legally bound unless he later assents to the changes. In other words, the acceptance of an offer must be absolute and unconditional and exactly according to the terms of the offer in every respect. The offer must be intended to create and capable of creating legal relations.

If there is no limit set upon the time of acceptance of the offer, it may be withdrawn at any time prior to its acceptance, except at common law "an offer under seal cannot be revoked."

If the person receiving the offer has mailed or telegraphed an acceptance previous to the receipt by him of the withdrawal of the offer, then the contract is completed and is legally binding.

The death of either party before acceptance causes an offer to lapse.

CONTRACTS ARE CLASSIFIED as contracts under seal and contracts of record.

A contract of record may be defined as a judgment whereby a sum of money is awarded to one of the parties to the suit by a court of record, and is an obligation upon one party to pay the amount so awarded to the other party concerned in the suit. When this judgment has been entered by the court it becomes a contract.

For a contract under seal no consideration is necessary and a longer time is allowed for action than in the case of the simple contract. A contract under seal acts as a merger of a former simple contract, and the parties to the contract are estopped thereby.

At common law it is necessary to have a contract under seal where the promise made is without any consideration; and all

conveyances of land must be made under seal in most jurisdictions.

CONTRACTS MUST BE IN WRITING. This covers bills of exchange and promissory notes under common law and by statute. In some states of the Union it is necessary to have in writing acceptance of bills of exchange and various orders for the payment of money, also the acknowledgment of a debt which has been barred by the statute of limitations, or the renewal of a promise previously made by an infant, when an infant has attained legal age.

In some other specified contracts the statute of frauds requires them to be in writing.

THE STATUTE OF FRAUDS is based on an old English statute relating to frauds and perjuries which was enacted in the year 1677, it being stated therein that it was enacted for the "Prevention of many fraudulent practices, which are commonly endeavored to be upheld by perjury and subornation of perjury."

The fourth and seventeenth sections are the ones which have a bearing on the forms of simple contracts, but do not, however, apply to contracts which are created by law, or instruments which by means of special statutes derive their obligations therefrom, nor to executed contracts. The reader is referred to works on the law of contracts for a full discussion of this question.

CONSIDERATION is one of the vital points of any contract, and is that which passes between the parties to a contract as payment for the performance of the contract.

This must be a valuable consideration, although not necessarily in money, but its equivalent; although if a negotiable contract has passed to a *bona fide* purchaser, the want of a consideration would not make the contract void.

The consideration does not have to be of necessity adequate, but must be something of value in the regard of the law, although the fact of the consideration being inadequate may be evidence of fraud and grounds for relief from a contract as proving fraud or undue influence.

While the consideration is not required to be in money or adequate in amount, it must have some real value, such as a *bona fide* act by one party or detriment suffered by the other.

One promise is sufficient consideration for another, but the promises must be concurrent, and while promises may be

contingent or conditional, they must be mutual so that both parties are bound or neither is bound.

Forbearing to do a thing may constitute a consideration, but when one is legally bound to do a thing, the mere promising to do it does not constitute a consideration, as the forbearing may arise from a previous contract or by reason of some law.

It is no consideration to make a promise to do a thing which is impossible on account of some law, and a promise must not be foregoing any legal right.

A consideration cannot be provided for by promising to do something which is illegal or by doing that which is illegal.

The consideration cannot be considered past unless it was given at the request of the promisor, or where the promisee agrees to pay for something voluntarily done, which could be legally required of the promisor, or where the person by making a new promise revives an old agreement which is not void and under which he was benefited, but which may become void by reason of law.

THE CAPACITY OF PARTIES TO MAKE CONTRACTS is a very important thing in any kind of a contract, and incapacity may result from political status, professional status, youth, idiocy, insanity, drunkenness, merger of capacity, or artificiality of construction.

The authorized agents of the United States or states, but only in case they further the business of the government and comply with the regulations of the Constitution of the United States and the states, may bring suit on their contracts, but can only be sued subject to constitutional provisions and provisions of the states.

A contract cannot be enforced against foreign states, sovereigns, or their representatives, but they can enforce contracts in our courts, provided, of course, that if they submit to suit the contract can be enforced against them.

Aliens or alien enemies have power to make contracts exactly the same as citizens, and they may be sued and sue on contracts, but this does not apply to alien enemies during hostilities, except upon the consent of the government, although there may be exceptions to this. An alien enemy, however, may be sued on a contract already in existence, and in such an event defend the same, and a war does not dissolve contracts which

were in existence previous thereto, except those which were continuing in nature.

Convicts may sue and be sued upon contracts, unless prohibited by the state, and they can also make contracts, unless it is prohibited by the state.

A lawyer or barrister in England cannot bring suit for payment for his services, but this restriction does not exist in the United States.

CONTRACTS MADE BY INFANTS are subject to such numerous rulings in law that the reader is referred to a treatise on the law of contracts for a full discussion of the subject, it being enough to say here that some of the contracts made by an infant are valid ones, while a few in some states are void, but most of them may be simply avoided at the option of the infant.

CONTRACTS MADE BY AN INSANE PERSON may be avoided at his option with the exception of contracts which have been created by law, or quasi contracts. Also in many jurisdictions where the sane party acted without actual knowledge of the other party's insanity and the contract is made in good faith.

Contracts made with an insane person are void in many jurisdictions when the contract has been made by a person declared insane by the courts and where a guardian has been appointed.

In some jurisdictions, deeds made by an insane person are void, and in many jurisdictions powers of attorney or agency are void if executed by an insane person.

CONTRACTS MADE BY A DRUNKEN PERSON, when so drunk as not to be able to understand the nature or facts, may be avoided at his option except that he is liable the same as an insane person where contracts are created by law or are quasi contracts.

Most of the rules relating to the contracts of drunken persons are exactly the same as those relating to infants and insane persons.

THE LAWS RELATING TO CONTRACTS MADE BY MARRIED WOMEN vary so much in the different states that they will not be referred to here, but the reader should look up any particular case in an authority on the subject.

CORPORATIONS ARE ARTIFICIAL IN THEIR NATURE and their contracts can only be made by an officer of the corporation duly authorized to do so by the articles of incorporation or by-laws

of the company, and unless restricted by its charter may sign contracts in the same manner as an individual, although it is usually advisable, but not always necessary, to use the corporate seal upon a contract.

MUTUAL AGREEMENT. It is necessary in every contract that the agreement be mutual, or in other words, the parties thereto must have the same understanding about the subject-matter, and it may happen that there is no real consent to the contract because of a mistake, misrepresentation, fraud, duress, or undue influence.

Mistake is where one party understood one thing and the other party a different thing from the wording or construction of the contract, or possibly both may have meant the same thing but had a different idea as to the subject-matter of the contract itself. In case mistake is proven, it will, in many cases, void a contract, although there is, of course, nothing criminal about it.

Misrepresentation is where, without any criminal intent, one party has given the other party a wrong understanding, and as this is not mistake, it simply renders a contract voidable.

Fraud is where the misrepresentations have been made intentionally, and when proven, the contract is voidable at the option of the party injured.

Duress is where one party has been forced to sign a contract by reason of threats of violence or imprisonment either to himself or to one of his immediate family, and it must be proven to make the contract voidable at the option of the party who has received the injury.

Undue influence is where a person is induced to sign a contract by reason of advantage having been taken of his weakness of mind, insanity, or by reason of some authority held over him. When this is proven the contract is voidable at the option of the injured party.

THE OBJECT OF THE CONTRACT MUST BE LEGAL. In case the object of a contract is not legal, the agreement cannot be enforced and is therefore in reality no contract at all. Such contracts may consist in a violation of some actual law or may be merely against public policy. Where the contract violates a positive law, it may be either some rule of common law or a statute. Where it is a violation of a common law, it may be one involving the commission of a crime or a civil wrong.

In certain cases the lawmaking body may by statute pro-

hibit the making of certain contracts, such as the regulation of particular lines of business or commerce, the sale of liquors, Sunday-closing laws, established rates of interest, and laws against public policy.

Public policy may be violated in contracts tending to hurt or injure the public service, tending towards the corruption of private citizens in public matters, contracts to obstruct justice, or encourage litigation. This policy may be violated also by contracts which are immoral in tendency, which refer to gambling transactions, or which tend to fraud, betrayal of trust, or affecting the marriage or parental relation.

The most usual form of contract against public policy is one which is made between business firms or corporations in restraint of trade, such as control of output of commodities or the killing of competition, which, of course, tend to create monopoly; and under the head of corporate wrongs might also be cited the exempting of corporations as well as individuals from legal liability for negligence.

Promises in illegal contracts to make remuneration in money are nearly always void, unless the contract has been purchased in a *bona fide* manner by other parties, in which case there may be, under certain laws, an enforcement of the contract.

CONTRACTS IN THEIR OPERATION cannot generally involve a person who is not a party to them, except in a case where one of the parties to a contract simply acts as the agent of another, or where the contract has been assigned to other parties in a legal manner, but in some states other parties may be involved by statute.

Where a contract is one of employment, it of course imposes an obligation on other persons not to interfere and endeavor to make the employee break the contract; and some courts have gone so far as to declare that the principle holds in all contracts.

Rights cannot be conferred by contract upon a third person except where the promisor becomes a trustee for the benefit of other parties, or where money passes to the promisor for a third party, in which case this third party can legally sue for the same.

Other parties than those making a contract may become interested in the same by the voluntary acceptance of an assignment, or through the provision of some law, such as the

transferring of rights in land upon a woman's marriage, or by reason of death or bankruptcy.

Contracts where more than one party is involved upon one or both sides may be joint, several, or both joint and several.

CONTRACTS ARE INTERPRETED by evidence and rules of construction.

Where a contract is alleged to have been made verbally, the facts in reference thereto are questions for the jury; as to whether or not these facts constitute a contract is a question of law for the courts to determine, and if a person is proven to have entered into a contract verbally upon certain conditions, he cannot deny what he stated at the time the contract was made.

Where a contract has been entered into verbally and later reduced to writing, parol evidence cannot be offered thereafter to alter the same; and if the contract is one that has been made under seal, it in itself is at common law proof of the contract.

Where there is a statement in writing of the contract, and not under seal, it is only evidence of a contract and not one in itself.

Construction of a contract is governed by very general rules. The plain and usual meaning of words is to be taken as governed by ordinary usage, but technical terms are to be understood in their technical sense. The construction which will best carry out the intention of the contracting parties is the one that should be held to, and this intention should be gleaned from the entire contract and not from a portion thereof.

Other minor rules are that grammatical mistakes which are obvious will be corrected. Generally words must be specific with reference to the subject of the contract. Where two meanings can be given to the contract, the one will generally be used which will make it valid, and it will also be interpreted in a reasonable rather than an unreasonable sense. The party using certain words in a contract will have them interpreted most strongly against him. Where there is a question of doubt, the meaning placed upon a contract by the parties thereto will be used, except where there is a conflict between the printed matter and any portion in writing, in which case the written words will control.

Time must always be considered as the essence of a contract

at common law, but in equity it is otherwise, unless it was intended by the parties to make time of the essence by express terms or fair implications. Where such an intention is absent a reasonable time will be given.

A penalty or liquidated damages is an amount fixed upon by the parties to a contract to be forfeited in case of default. Treatment is distinctly set forth in "Clark on Contracts" as follows:

"It may be recovered if it was really fixed upon as liquidated damages for non-performance. This is subject to the rules of construction stated below.

"But if it was intended in the nature of a penalty in excess of any loss likely to be sustained, the recovery will be limited to the loss actually sustained.

"In determining whether the sum named is a penalty or liquidated damages, these rules may be stated:

"The courts will not be guided by the name given to it by the parties.

"If the matter is of uncertain value, the sum fixed is liquidated damages.

"If a debt is to be paid by installments, it is no penalty to make the whole debt due on non-payment of an installment.

"If some terms of the contract are of certain value, and some are not, and the penalty is applied to a breach of any one of them, it is not recoverable as liquidated damages."

Joint and several contracts are also treated by the same author as follows:

"Whether or not a contract with several persons on either or both sides is to be construed as joint or several depends upon the intention of the parties as manifested in the evidence of their agreement. The following rules may be stated:

"A promise by two or more in the plural number is *prima facie* joint, while a promise in the singular is *prima facie* several; but this presumption will yield if, from the whole agreement, a contrary intention appears.

"Subscriptions by a number of persons to promote some common enterprise, though joint in form, are several promises.

"If the words will admit of it, the contract, as regards the promisees, will be joint or several, according as their interest is joint or several."

CONTRACTS MAY BE DISCHARGED, or in other words, legally fulfilled, by reason of an agreement between the contracting parties, which may be in the form of an offer to cancel, or another contract to be substituted for it; or discharged by reason of some clause in the original contract which cancels it.

An agreement for the discharge of the contract must be in the same general form as any other contract.

The discharge of a contract by performance is where a promise has been carried out by the promisor and also where one promise has been given as a consideration for another and both of them have been performed.

Performance may also consist in the making of payment in full as set forth in the contract, or this payment may consist of a continuing payment made in legal form.

Where one of the parties to a contract breaks it, the rule is that the one injured has the right to legal action and in some cases it fully discharges the contract, although this will depend upon circumstances.

The discharge may consist in impossibility of performance; but this will not discharge a contract legally, except where the conditions have been created by law or where the subject referred to in the contract has been disturbed, or where a person has been incapacitated for rendering personal services.

Bankruptcy also effects a release from a contract where the court has given an order of discharge to the bankrupt.

The remedies to be had by the injured party upon the breaking of a contract are that he is not required to make any further performance of the contract; he may sue upon the contract for work done thereon; or a suit may be brought for damages by reason of loss sustained, or for the specific performance by the other party to the contract.

QUASI CONTRACTS. "Contracts in Fact" are usually the only ones where a legal action can be maintained. There are, however, cases where the law will create a fictitious promise, so that redress may be obtained by "action of assumpsit." This is what is meant by a "Quasi Contract."

These may be based upon a court judgment; a statutory, official or customary duty; or the theory that for one person to profit at the expense of another is an injustice.

"Whenever one person requests or allows another to assume

such a position that the latter may be compelled by law to discharge the former's legal liabilities, the law imports a request and promise by the former to the latter, — a request to make the payment, and a promise to repay, — and the obligation thus created may be enforced by *assumpsit*."

"Wherever one person has money to which, in equity and good conscience, another is entitled, the law creates a promise by the former to pay it to the latter, and the obligation may be enforced by *assumpsit*."

"Under certain circumstances, where one person has conferred upon another benefits in the way of property, services, etc., and cannot show a promise in fact by the latter to pay for them, the law will create an obligation, because of the receipt of the benefits, to pay what they are reasonably worth."

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